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Evaluating the Effects of Camp Reach on the Middle School Teachers

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Abstract

Camp Reach is a two-week residential program in Massachusetts where middle-school girls participate in STEM (Science Technology Engineering & Math) related activities with middle school teacher (MST) assistance. This study's goal was to evaluate the effectiveness of Camp Reach as a professional development program, which was achieved using data analysis of end-of-program evaluations and follow-up interviews. The results showed that teachers' knowledge of engineering and classroom usage of engineering increased, and led to the recommendation that the MSTs be provided with a lesson plan that can be utilized directly in their classrooms based off certain camp activities.

Acknowledgements

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Executive Summary

Camp Reach is a two-week residential summer program for seventh grade girls that is hosted by Worcester Polytechnic Institute. The middle school girls participate in STEM (Science Technology Engineering & Mathematics) activities with middle school teachers that facilitate the activities. Camp Reach is considered to be a STEM professional development program. The goal of this project was to analyze research on the past teacher participants of Camp Reach. The goal was achieved by focusing on the short-term and long-term effects of this summer program through end-of-program evaluations and interviews with past middle school teacher participants. Following are the sequential objectives of this project and the methods we used to achieve them:

1. *Identifying short-term effects of Camp Reach on the middle school teacher participants.* Teachers completed end-of-program evaluations on the last day of Camp Reach, providing information on how they intended on utilizing the acquired knowledge and skills from the program. The end-of-program evaluations were collected, organized and analyzed. There were two types of questions on the evaluations: closed form and open form. The closed form questions were analyzed and shown in terms of averages. The open form questions were analyzed using an inductive analysis approach. Major steps in this approach include repeatedly reading the data to understand it and recognizing common themes among the data.

2. *Identifying long-term effects of Camp Reach on the middle school teacher participants.* Camp Reach has been operating for 15 years. Therefore, long-term effects on teachers may range from one to 15 years. Long-term effects of Camp Reach on the middle school teacher (MST) participants were found through interviews. The purpose of the interviews was to discover what, if anything, the teachers learned about engineering from the program. Also, our team wanted to find out in what ways, if any, are the teachers spreading their engineering related knowledge learned from Camp Reach outside of their classrooms. Finally, we wanted to determine what Camp Reach activities, if any, did the teachers implement in their school. A total of 17 interviews out of 42 possible interviews with past Camp Reach middle school teachers (MSTs) were performed. All the interviews were performed over the phone, with the exception of one being conducted in person. The qualitative data obtained through these interviews was analyzed in a similar process to the qualitative short-term evaluation data. This consisted of us reading through the data several times to understand it, creating categories and then refining them multiples times. The emerging themes from the interview data involved knowledge about engineering, teaching activities and methods, and reflections on Camp Reach.

3. *Developing recommendations for the improvement of Camp Reach.* All of the data we gathered through both the end-of-program evaluations and teacher interviews

aided us in making recommendations to improve Camp Reach as a professional development program.

FINDINGS

Short-Term Effects of Camp Reach

The three main themes found in the evaluations were as follows:

1. What teachers' learned about engineering: The middle school teachers expressed that their knowledge of engineering had increased, specifically on the topic of the engineering design process and different engineering career opportunities. Seven teachers explained learning that engineering involves team work, creativity and brainstorming. Four teachers stated that they learned that engineering is about communication, problem solving, and trial and error.

2. Teachers' plans for implementing engineering activities: Multiple themes emerged from the short-term data regarding what the teachers intended on utilizing from Camp Reach. Eight teachers indicated their plans to include aspects of the engineering design cycle in their classrooms. There were 31 teacher comments that mentioned wanting to incorporate specific Camp Reach activities such as: the design project, Wacky Shoes, Dance Pad and Forensics.

3. Teachers' feelings of staff training and suggestions for improvements: Both qualitative and quantitative data indicated that the teachers were satisfied with Camp Reach at the end of the program. Of the 18 available end-of-program evaluations, 14 thought that the staff training was well organized and helpful. In addition, seven teachers generally stated that more time was needed for the workshops.

Long-Term Effects of Camp Reach

The emerging themes from the interview data were as follows:

1. Knowledge about engineering: All 17 teachers indicated that their knowledge of engineering was enhanced after Camp Reach. There were 14 middle school teachers (MSTs) that explained in what ways their knowledge changed. For example, teachers knew more about engineering as problem solving and increased familiarity with the engineering design process. Four teachers claimed they were able to more readily identify the process. Without prompting, two teachers said that they are able to teach an engineering unit in their classrooms. Teachers also mentioned misperceptions about engineering that they come across in and outside their classrooms. Five of the 17 teachers claimed there is the misperception of engineering being a career for males, while four teachers stated that girls are not as interested in engineering and that they do not think that there are enough women in this field.

2. Teaching activities and methods: The middle school teachers also indicated specific activities and skills acquired from Camp Reach and ways of utilizing them in their classrooms. Five teachers stated that they have incorporated activities from Camp Reach into their classrooms. Two teachers expressed that they are utilizing the engineering design process in their teaching. Multiple teachers claimed that they had difficulty incorporating engineering activities in their classrooms due to curriculum restraints. Eleven teachers explained that the Massachusetts or district requirements make it difficult for them to incorporate any out-of-curriculum lessons.

RECOMMENDATIONS

Recruit more teachers from the same school: We believe that recruiting teachers from the same school or district to attend Camp Reach simultaneously would better allow them to discuss teaching activities and methods they can incorporate in their classrooms.

Recruit and accept more engineering and technology teachers: Most of the middle school teacher participants are math and science teachers and believe that curriculum restraints hinder their ability to use Camp Reach activities in their classrooms. By accepting more engineering and technology teachers, there would be fewer restraints and more possibilities of incorporating Camp Reach activities into their classrooms.

Provide teachers with lesson plans that can be implemented in a typical classroom schedule: One of the characteristics of an effective professional development program (PDP) is the teachers leave the program with an implementable lesson plan for their classrooms. From the interviews, the teachers expressed that having this type of lesson plan would make it easier for them incorporate Camp Reach activities.

Reprogram camp activities to better fit with the Massachusetts curriculum standards: The teachers made it clear that the Massachusetts curriculum allows for little flexibility and makes it hard to incorporate outside material. We recommend that the camp directors familiarize themselves with the Massachusetts curriculum so that some activities can be reprogrammed to better fit into the state curriculum.

Contributions

Lauren D'Angelo, Brittany Dellasanta and Nisha Patel all contributed to the research and writing of this report. The following is a breakdown of how the report was written:

Lauren D'Angelo was responsible for portions of the Introduction and the section of the Background and Literature Review relating to Camp Reach. She also wrote the third section and contributed a portion of the second section of the Methodology chapter, and the second section of the Findings chapter. Lauren also wrote the majority of the Recommendations section, and was responsible for formatting and compiling the entire report. She also participated in editing of the entire paper and the formation of the codes listed in Appendices C and D. Finally, Lauren participated in the majority of the teacher interviews.

Brittany Dellasanta was responsible for portions of the Introduction and the section of the Background and Literature Review related to the challenges of integrating engineering into classrooms and improving and increasing STEM education. In addition, she wrote the first section and contributed to the second section of the Methodology chapter, the first section of the Findings chapter, and the majority of the Conclusions section. Brittany was also responsible for editing the entire paper, the letter to teacher participants in Appendix A and the codes shown in appendices C and D. She also compiled the final Bibliography. Finally, Brittany participated in the majority of the teacher interviews.

Nisha Patel was responsible for the writing of the Abstract and Executive Summary, as well as portions of the Introduction. She also wrote the sections of the Background and Literature Review related to the need for a diverse engineering workforce and the lack of growing interest in engineering, and the majority of the second section of the Methodology chapter. Nisha also wrote portions of the Conclusions and Recommendations section. She participated in editing the final draft of the paper. In addition, Nisha participated in selected teacher interviews.

Table of Contents

List of Tables

Chapter 1: Introduction

The engineering field has been drawing attention as a workforce critical to the economic and global success of the United States (Blue et. al, 2005; National Academy of Sciences, National Academy of Engineering, and Institute of Medicine 2007). In the United States, citizens' minimal understanding of engineering contributes to the nation's general shortage of engineers (Cunningham, 2007). Moreover, diversity is seen as an important aspect of any workforce and there is an underrepresentation of minority groups, especially women, in engineering (Cunningham, 2007; National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2007; NSF, 2011). One potential reason for the shortage of engineers may be an inadequate amount of time spent teaching engineering related topics to K-12 students (Kimmel et al., 2007). General education is lacking the activities and curriculum to spark an interest in engineering. Further contributing to this nationwide problem is that school teachers do not have a full understanding of the engineering design process to incorporate it into their curriculum (Kimmel et al., 2007).

Integrating engineering into K-12 classrooms is one way of attempting to recruit more youth into engineering education and careers (Lambert, 2007; Miaoulis, 2010). Although primary school teachers' expertise includes approximately 18 years of primary and secondary education, there are gaps in their schooling (Vrasidas, 2004). Few teachers are taught some of the engineering discipline while completing their own education and therefore feel uncomfortable integrating the subject into their classrooms (Cunningham, 2007). Studies have shown that most teachers do not comprehend engineering, resulting in their inability to correctly teach this subject to their students (Lambert et al., 2007; Yasar et al., 2011).

One possible way to help address this problem is through professional development programs. Professional development programs help teachers develop the content, knowledge, and skills that they need to succeed in their classrooms (Vrasidas, 2004). It is said that "teachers are viewed as reflective practitioners who have the implicit knowledge base and who construct and re-construct knowledge to strengthen that base" (Posnaski, 190, 2002). Professional development programs help school teachers improve their knowledge base. Teachers are encouraged and often required by their school districts to attend professional development programs, which provide them knowledge in different subjects (Vrasidas, 2004). Some professional development programs focus specifically on certain subject areas. For example, a STEM (Science Technology Engineering & Math) professional development program may teach educators about the engineering design process as well as how it can be incorporated into their classrooms.

Many institutions and universities offer STEM professional development programs (NSF, 2011). One such program is Camp Reach, an all-girl two-week program hosted by Worcester Polytechnic Institute (WPI). Each summer 30 seventh grade girls attend Camp

Reach, along with a specially selected staff that assists them in activities focused on STEM subjects. Among the staff are three middle school teachers that observe and assist in different engineering activities. This aspect of the program allows Camp Reach to not only serve as a summer camp for girls, but also as a professional development program for teachers. As a professional development program, Camp Reach aims for its teacher participants to gain a better understanding of engineering, learn new ideas of applying the engineering design process in lessons, and adapt some of the workshops or activities into their classrooms (Camp Reach, 2011). While effects of the program on campers have been studied, there is little known regarding the amount of knowledge that the teachers have taken from Camp Reach and whether the knowledge they gained has aided them in their teaching.

The goal of this project was to analyze if and how Camp Reach affected its past middle school teacher participants. This information was then applied to develop recommendations for strengthening Camp Reach as a professional development program. This study was designed to probe whether the teachers had any changes in opinion of engineering and if they integrated anything at all that they learned from Camp Reach into their classrooms. Initial data was collected through evaluations filled out by the teachers at the close of Camp Reach. These surveys had not been systematically analyzed before. We followed up with interviews of the 17 of 42 teacher participants of Camp Reach from 1997-2011 to explore the long-term effects of the camp. Finally, conclusions from the end-of-program evaluations and the teacher interviews were drawn and analyzed to make suggestions on improving Camp Reach for middle school teachers.

Chapter 2: Background and Literature Review

Engineering is a slowly growing career choice among students in the United States, due in part to the lack of interest in the subject (Blue et al, 2005). A possible reason for this is the insufficient amount of focus on engineering at the K-12 grade levels (Cunningham, 2007). While STEM (Science Technology Engineering & Math) subjects are being taught and incorporated into curricula, there is noticeably less engineering material compared to the other three subjects (Miaoulis, 2010). In this chapter we will explain the negative outcomes concerning the shortage of engineers, emphasizing the lack of minorities, specifically females, involved in this career. We will then discuss the challenges teachers have implementing engineering into their classrooms, as well as what is currently being done to resolve this issue. Finally, we will address how Camp Reach is working to solve this problem.

2.1 Scarcity of Engineers in the US Workforce: Potential Consequences and Contributing Factors

Engineering has been drawing attention as a workforce in which the demand has exceeded the supply of new engineers (Blue et. al, 2005; National Academy of Sciences, National Academy of Engineering, and Institute of Medicine 2007). In a study conducted by the National Science Foundation (NSF) in 2003, there was an estimated 7.3% growth rate in the number of workers in the engineering field, compared to the 36% growth rate of workers in other science related fields (NSF, 2003). This shows that there was a small growth in the engineering workforce, but it was not significant enough to meet the high demand for engineers. It also shows that in comparison with other science related workforces, engineering is lacking in numbers. A similar study done by the Institution of Engineering and Technology (IET) yielded similar results (Zwang, 2011). In this section, we will discuss how increased diversity in the engineering workforce would help strengthen it, as well as the contributing factors to the lack of growing interest in engineering. Finally, we will address the challenges of integrating engineering into classrooms.

2.1.1 Need for a Diverse Engineering Workforce

An area of concern in the engineering workforce is the lack of diversity (Johnson, 2004; NSF, 2011). There are various benefits to having a diverse science and engineering workforce. Diversity provides creative ideas and discoveries that contribute to the success of a particular field (Blue et al., 2005; Page, 2007). Scott Page, author of "The Difference: How the Power of Diversity Creates Better Groups, Firms, Schools and Societies", discusses how diverse groups are more intelligent and stronger compared to homogeneous groups because of their increased number of perspectives and contributions (Page, 2007). This leads to more innovation. Also, companies with gender diversity proved to be more

financially successful (The Catalyst Information Center, 2010). Diversity also has a positive effect on connecting with different communities of people (The Catalyst Information Center, 2010). All of these are reasons as to why numerous professionals try to achieve diversity in their particular fields.

Women and minorities make up a significant portion of the population, yet when looking at the statistics presented in studies, both groups are underrepresented in the engineering and science fields (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine 2007; NSF, 2011). Their participation in college enrollment and employment in said fields is not sufficient (NSF, 2011). The ratio of men to women studying engineering in college is five to one (Carlson & Sullivan, 2004), which is reflected by the 74% of men in the engineering work force (NSF, 2011). Despite the ongoing efforts of organizations, including universities, to increase the number of females in the engineering and science community (Blue et al., 2005), there has not been any significant progress in attracting more women to the field (NSF, 2011).

Minorities are vastly underrepresented in the engineering population (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline, 2011; NSF, 2011). The United States' minority population is 28% of the nation's total population and only 9% of those people work in the science and engineering fields (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline, 2011). It is predicted that in the future the minority population will rise, thus increasing the amount attracted to the science and engineering workforce. In turn, this will increase the diversity in said fields (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline, 2011).

2.1.2 Lack of Growing Interest in Engineering

Numerous studies have indicated that both female and male students nationwide are expressing little interest in engineering (Blue et al., 2005; Degenhart, 2007; Johnson, 2004). If students do not view engineering as an appealing subject, then they will not choose it as a career option, further contributing to the lack of engineers (Degenhart, 2007; Kimmel et al., 2007). There are various explanations to this lack of interest in engineering. These reasons include the difficulty of the curriculum, the low self-efficacy of students, specifically females, as well as little understanding of STEM (Science Technology Engineering & Math) subjects (Blue et al., 2005; Johnson, 2004) and stereotypes and perceptions of the engineering field. Each of these factors will be further described in this section.

High school students face the uncertainty of their futures, including which career they wish to pursue and which they will be most successful in (Blue et al., 2005; Cunningham, 2007; Johnson, 2004). Students who excel in the poly-sciences during high school are encouraged to look at science, math, or engineering futures. Since engineering majors are difficult and require a great deal of commitment, some students are discouraged from the subject and

select different majors (Blue et al., 2005). The rigorous curriculum largely contributes to students' disinterest in engineering (Cunningham, 2007; Degenhart, 2007; Kimmel et al., 2007). In another study by the National Academy of Engineering, it was stressed that the rewards of the being an engineer were not recognized. These rewards include having a flexible career, making a difference in society, and a fairly high income (Committee on Public Understanding of Engineering Messages, 2008).

Next, low self-efficacy and self-confidence are two possible causes for disinterest in engineering, especially for women (Vogt, 2005). The difference between self-confidence and self-efficacy is not always clear. Self-confidence is assurance in one's own judgment and ability, while self-efficacy is defined as "a judgment of one's capabilities to execute specific behaviors in specific situations" (Miller & Parajes, 193, 1994). Low self-confidence in a subject can drive students away from it (Degenhart, 2007). Self-efficacy may be altered by certain external factors such as support systems, classroom environment, and available resources (Miller & Pajares, 1994; Vogt, 2005). In a study examining the self-efficacy of middle school students, results indicated that students' beliefs of how well they perform in a certain subject affects whether or not they plan to pursue a career in one of the STEM (Science Technology Engineering & Math) subjects (Degenhart, 2007; Miller & Pajares, 2007). There have been many studies done to understand why young females are not interested in engineering, and results have shown that low self-confidence and self-efficacy in the subject are significant reasons (Degenhart, 2007; Vogt, 2005).

Another possible cause for lack of interest in science and engineering involves stereotyping. As previously mentioned there are fewer women in engineering in comparison to men (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline, 2011; NSF, 2011). A common stereotype is that science and engineering fields are primarily for males (Degenhart, 2007; Vogt, 2005). Stereotypes such as this cause females to feel as if they do not belong in those fields (Vogt, 2005).

Another contributing factor to a student's attitude or interest towards engineering is their perception of engineering. Unfortunately, many middle and high school students misunderstand the role of engineering professionals in society (National Academy of Engineering, 2008; Thompson, 2011). There are misperceptions among many students due to the lack of exposure of engineering material in school (Degenhart, 2007; National Academy of Engineering, 2008). A study on public attitudes and perceptions of engineering claimed that students ages 15 to 18 had a limited understanding of the subject (Marshall et al., 2007). This age group associated four words with engineering: building, construction, mechanics and electronics, showing their limited understanding. Another study showed that the publics' comprehension of engineering was restricted to "construction" and "fixing things" (Marshall et al., 38, 2007). There are some aspects of engineering that need to be better communicated such as innovation, problem solving, and creativity (Marshall et al., 2007). Motivational factors play a role in the success rate for students, specifically females, in a certain subject (Vogt, 2005). Researchers have made it evident that when a person has a positive outlook on a subject they will have a higher success rate, while a person with negative outlooks will not (Degenhart, 2007; NSF, 2003, Vogt, 2005).

Students may also avoid engineering fields due to their lack of knowledge in STEM subjects (Zwang, 2011). The 2009 National Assessment of Educational Progress (NAEP) reported unsatisfactory results in science on a nationally standardized test for all levels of education. It showed that the percentage of students above the basic knowledge level decreased as the students made progress in school (Zwang, 2011). United States Secretary of Education, Arne Duncan, commented, "'The results... show that our nation's students aren't learning at a rate that will maintain America's role as an international leader in the sciences. When only one or two percent of children score at the advanced levels on NAEP, the next generation will not be ready [to work as] world-class inventors, doctors, and engineers'" (Zwang, 1, 2011).

2.1.3 Challenges Integrating Engineering into Classrooms

There are difficulties associated with incorporating engineering in K-12 classrooms. Primary and secondary school teachers educated in mathematics, science and technology are essential in achieving both science and mathematics literacy for students (NSF, 2003). While the importance of teaching STEM (Science Technology Engineering & Math) in grades K-12 is evident, some professionals question whether engineering should be taught at this level. This section will first focus on a two-sided argument regarding engineering education at these levels, followed by the many challenges of integrating engineering into classrooms. These challenges include the misperceptions of engineering, constraints on the curriculum and teachers, as well as constraints on the teacher's education.

After many efforts made by organizations such as universities in the United States, teachers continue to have a poor understanding of engineering as a career (Committee on Public Understanding of Engineering Messages, 2008). Inadvertently, teacher misperceptions may be passed on to their students (Marshall et al., 2007; Thompson, 2011). In a study that researched the perspectives of P-6 grade teachers of engineering, teachers related building, construction, and improving products to engineering. Most participating teachers failed to include key words related to engineering such as creativity, teamwork, and communication. Many teachers also failed to recognize that engineering is everywhere and affects our daily lives (Beck et al., 2007). The results of a study conducted by the American Society for Quality illustrate that teachers do an insufficient job of communicating STEM careers and encouraging students towards those fields (Thompson, 2011). Ken Reid, director of freshman engineering at Ohio Northern University, stated that "[t]he most effective way to reach students is through the influence of a teacher who inherently integrates the principles of engineering into everyday learning" (Thompson, 1, 2011).

Currently there are arguments in support of and opposed to teaching engineering prior to college. Ioannis Miaoulis, Director of the Boston Museum of Science, is perhaps one of the nation's leading advocates for engineering in the K-12 grade levels. In a recent publication Holistic Engineering Education: Beyond Technology (2010), he offers his opinion that engineering should be a part of the core curriculum in grades K-12. He reasoned that

everything in this world is engineered in one way or another and students should know how everything in this world comes about. Supporters agree that engineering is as significant as other courses that are being taught (Miaoulis, 2010). It is also argued that engineering teaches students how to problem solve and this skill is more valuable than the majority of the aspects in the current curriculum (Miaoulis, 2010; Rover, 2011). Teaching engineering also reinforces critical math and science skills that are required for students to learn for standardized tests (Rover, 2011). Engineering education can improve the achievement level of students, increase the interest and awareness of engineering for students, and move their attention towards engineering careers (Brophy et al., 2008; Brown, 2009; Hill, 2006). Others educators argue that students already have a packed schedule and adding engineering would be overwhelming (Hu, 2010). Some who have written on the subject also question the amount of engineering material young students actually learn if it is a part of their classrooms (Hu, 2010; Kimmel et al., 2007). William E. Kelly, former dean of the engineering school at Catholic University in Washington and a spokesman for the American Society for Engineering Education, says that engineering lessons that are being taught in classrooms need to be evaluated (Hu, 2010). He questions if the content and presentation of the lessons are being taught with the students' best interest in mind (Hu, 2010; Thompson, 2011).

Regardless of these arguments, teachers of the K-12 curriculum face their own challenges. The pressure to improve education in this subject has increased (Thompson, 2011). In 2000, Massachusetts became the first state to incorporate engineering standards into their primary schools (Miaoulis, 2010). By 2006 Massachusetts created the second edition of the "Massachusetts Science and Technology/Engineering Curriculum Framework," the most recent publication of this type (Massachusetts Department of Education, 2006). The framework states that the reason for incorporating technology and engineering into education is to "enable students to draw on these skills and habits, as well as on their subject matter knowledge, in order to participate productively in the intellectual and civic life of American society and to provide the foundation for further education in these areas if they seek" (Massachusetts Department of Education, 15, 2006). The publication then states the standards required at each grade level, as well as suggestions on how to accomplish them. It also notes that students in grades six through eight are suggested to take a technology or engineering class for an entire year, apart from the science requirements.

The Massachusetts curriculum framework first defines engineering design as an "iterative process that involves modeling and optimizing to develop technological solutions to problems within given constraints" (Massachusetts Department of Education, 95, 2006). It then continues to outline the Engineering Design Learning Standards for the middle school level, defining its six objectives:

- Identify and explain the steps of the engineering design process, i.e., identify the need or problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign
- Demonstrate methods of representing solutions to a design problem
- Describe and explain the purpose of a given prototype

- Identify appropriate materials, tools, and machines needed to construct a prototype of a given engineering design
- Explain how such design features such as size, shape, weight, function and cost limitations would affect the construction of a given prototype
- Identify the five elements of a universal systems model: goal, inputs, processes, outputs, and feedback

(Massachusetts Department of Education, 95, 2006)

These standards are accompanied by Construction Technologies Learning Standards, all of which fall into the following subtopics:

- Materials, Tools and Machines
- Engineering Design
- Communication Technologies
- Manufacturing Technologies
- Construction Technologies
- Transportation Technologies
- Bioengineering Technologies

Lessons for these topics include understanding the five steps to the technology system, the basic safety skills of machines and tools, and exploring engineering design. These topics are suggested to be taught using hands-on activities, some of which are exemplified in the publication. It is also suggested that technology teachers, or teachers knowledgeable with tools and machines, run the engineering and technology class that teaches the above topics.

Miaoulis states that middle school science teachers should teach these subjects if the schools do not have a technology teacher. In addition, he states that the engineering curriculum should flow from grade level to grade level, suggesting that the teachers of each level collaborate on creating an engineering curriculum for K-12. Teachers are also encouraged to work together across a grade level when evaluating and using the existing engineering curriculum. Miaoulis did not give a timeline as to how many hours per week should be spent on teaching engineering[1].

In general, sixth through eighth grade teachers are limited to teaching certain subjects, such as math and science, to help students on standardized tests, according to Miaoulis (2010). Due to this and other curricula requirements that need to be fulfilled, the curriculum they must cover is very restrictive. In addition, Miaoulis says that there are territorial feelings teachers get, creating anger if their teaching time of a subject gets reduced due to the introduction of engineering or any new subject. Bringing engineering into classrooms also requires additional resources, such as someone to teach the subject and the funds to implement it. Many STEM teachers, specifically math and science teachers,

[1] It is important to note that the Framework specifically on technology and engineering within this document has not changed since the initial document was created in 2001, meaning the requirements in the subject have not changed in approximately 10 years. It is also worth mentioning that the majority of this document focused on science topics, such as Biology, Chemistry, and Physics, while grouping technology and engineering together for a single section.

do not feel apt for this job because they think it would be too difficult to adapt into their current lessons. (Miaoulis, 2010)

In addition to these teaching constraints, there is also a lack of science, technology and teachers educated in engineering (Miaoulis, 2010). There are few teachers who have the knowledge about engineering that is needed to create lessons (Kimmel et al., 2007). In order for them to acquire this knowledge, many teachers are encouraged to attend programs, a suggestion that does not easily coincide with their busy lives (Miaoulis, 2010). Even if teachers have a sufficient understanding of engineering, they are likely unaware of how to effectively incorporate it into their classrooms (Miaoulis, 2010). A final problem associated with integrating engineering into the classrooms is funding. Miaoulis (2010) notes that materials for engineering lessons come with a great deal of cost. The teaching of engineering can only be done to a degree without the proper equipment and labs (Miaoulis, 2010).

2.2 Improving and Increasing STEM Education

Given the challenges of integrating engineering into pre-service teacher education and the constraints of the formal K-12 education system, universities and professional organizations are playing a major role in advocating STEM (Science Technology Engineering & Math) education. These organizations provide engineering enrichment opportunities to students and professional development programs to teachers. In this section we outline useful techniques for teaching STEM subjects, specifically engineering, to young students. We will then outline different types of professional development programs, along with their advantages and disadvantages. Finally we will discuss traits that make professional development programs successful.

2.2.1 Encouraging STEM for Students

Teaching STEM subjects requires specific techniques to make it effective in engaging students (NSF, 2003). These techniques include hands-on and team activities, as well as applying knowledge to real-world problems (Cheng, 2008; NSF, 2003). One study showed that children were instantly more attracted to hearing about engineering when they realized engineers are the ones that create most of their electronics or everyday objects (National Academy of Engineering, 2008). Another way to increase students' interest in STEM subjects is by focusing on each student improving in work ethic and confidence through the process of solving STEM problems (NSF, 2003). Depicting the different roles and careers of STEM workers, such as scientists and engineers, can also have positive effects on the students (NSF, 2003). Students enjoy the open-ended aspect of engineering questions, as they can be creative and not strive to find the one path to the correct answer (Cheng, 2008). Conveying engineering to students using appropriate language and dialogue at their level helps them to better understand what engineering is (National Academy of Engineering, 2008). Depicting who an engineer is through a variety of different visual

images has also been helpful in stimulating their interest (National Academy of Engineering, 2008).

Utilizing the media to portray engineering and engineering design is also effective (Frey & Wolsky, 2006). Television shows that incorporate engineering and science fields are useful, as they can enforce certain areas of these topics, including positive images of engineering and the principles behind engineering, among many others (Frey & Wolsky, 2006). A popular example of such a show is PBS's "Design Squad," where students compete to complete different challenges that require engineering design (Cheng, 2008). The show not only depicts to viewers an example of the engineering design process at work, but also shows different engineering careers (Cheng, 2008). A teacher's guide to challenges seen in the show has also been successful in bringing fun engineering activities to the classroom (Cheng, 2008).

Colleges and other institutions are doing their best to help solve the problem of educating young students in engineering by creating programs that encourage these engineering learning techniques. Summer camps and after-school programs for students sponsored by the NSF (National Science Foundation) are found in all areas of the country, according to the NSF official website. These programs incorporate the ideas above into how they teach students engineering in an intriguing way. Other programs put on by colleges and institutions work as professional development programs to help educate teachers on improving their teaching.

2.2.2 Professional Development for Teachers

While there are numerous programs to help students learn and experience engineering, there is still a need to train teachers in these subjects (Garet et al., 2001). Professional development workshops and programs are a way that most teachers, as well as the states themselves, have gone about approaching this problem (Garet et al., 2001; Miaoulis, 2010). In Massachusetts, the purpose of professional development programs in primary and secondary schools is to continue teaching the educators so that as a school and as a state, educational goals will be met (Mass.gov, 2003). The National Center for Technology Literacy (NCTL), which provides professional development programs for current teachers and their supervisors, was created in 2000 as a result of the introduction of assessments in science and engineering in classrooms (Miaoulis, 2010). Each program is based on the requirements of the different states' professional development, and encourages colleges to assist with these programs (Miaoulis, 2010).

There are seven major types of professional development, according to Thomas Guskey in his book Evaluating Professional Development (2000). They are described in Table 1. Professional development programs that integrate numerous aspects of these different models can be more useful than one single program. While there are numerous types of professional development programs, not all are effective (Dunst & Raab, 2010). One factor

Table 1: Types of Professional Development Programs (adapted from Guskey, 2000)

Professional Development Program Type	Description
Training	• Consists of presenters expressing their ideas with others through group activities • Least expensive and most useful when trying to reach a large number of participants at once • Large downfall is the lack of individualization, such as for different level of participants
Observation and Assessment	• Receiving feedback on how the participants teach by those higher up, or by peers • Individualized program that provides each teacher with specific improvement ideas, and gives the person assessing the teacher a sense of how others are educating • Difficulty in timing because observation takes coordination between at least two people
Involvement in a Development/ Improvement Process	• Reviewing and learning about a certain subject in order to write professionally about it. • Helps teachers work with others and understand other people's views • Limited number of participants in this program, therefore it would not be useful for those at a large school.
Study Groups	• Splits the teacher population of a given school or district into groups that try to improve on the same given issue by dividing it up • Involves all teachers and focuses on the details of a larger issue • Downfalls include the ability for an individual to control their group, as well as the temptation to focus on opinions rather than facts
Inquiry/Action Research	• Follows five steps: o Select a problem or question of collective interest o Collect, organize and interpret information related to the problem o Study the relevant professional literature and research o Determine possible actions that are likely to achieve commonly valued goals o Take action and document results • Helps the teacher solve orderly problems and experience a researcher perspective. • Downfall is a substantial commitment by the teacher in terms of time and effort.
Individually Guided Activities	• Allows the teacher to decide on their own goal and follow up with activities that will help this goal be met • Advantages include flexibility, personal reflection, and independence • Downfalls are that the teacher usually comes up with the same solution to the problem as before the activity, and the teachers may not share this process and its results with other colleagues, making it an individual program.
Mentoring	• Based on a typical mentoring relationship, where a higher educator guides and assists another teacher. This relationship allows the teacher to reach their goals and gives the teacher individual attention. • Works well to accomplish goals, but only includes two individuals, excluding others from learning from this experience.

that makes a professional development program effective is a lengthy or long-term program, meaning that the program is not a one-day event, but provides continuous check-

ups and similar programs with the participants (Capobianco & Joyal, 2008; Desimone 2009; Desimone et al., 2002; Dunst & Raab, 2010; Garet et al., 2001; Gerard et al., 2011; Guskey, 2000; Guskey, 2003; Kimmel et al., 2007; Richardson, 2003; Vasumathi, 2010). Continuous follow-up of the program with meetings or activities with its participants is useful to be sure that the program was effective and the material learned is being applied (Guskey, 2009; Richardson, 2003; Vasumathi, 2010). Along this line, programs that structure their time well help make them valuable (Guskey, 2003).

In addition, professional development programs that focus on a specific academic subject, especially math or science, are found to be successful (Desimone et al., 2002; Dunst & Raab, 2010; Garet et al., 2001; Guskey, 200; Vasumathi, 2010), as are those that teach to how that subject is best learned (Desimone, 2009). Strong professional development programs focus on areas that need attention, making the teachers' time and effort at these programs worthwhile (Vasumathi, 2010). Also, effective programs provide teachers with activities and exercises related to their specific teaching subjects, as well as further assistance implementing these lessons into their classrooms (Dunst, 2010; Garet, 2001; Gerard et al., 2011; Guskey, 2000; Guskey, 2003). Professional development programs that engage in active learning, learning through interaction, and activities with the material being taught, have been found to be more useful than those that do not (Wayne et al., 2008), as are programs that acknowledge and plan according to the state and school framework (American Federation of Teachers, 2002).

Finally, effective programs assist the teachers in reflecting on their own teaching and how it can be improved with a new understanding of the topic, which often results in a change in their opinion (Vasumathi, 2010). School-wide professional development programs are also effective (Richardson, 2003), as are those that encourage teacher-teacher learning, a form of collective participation (Dunst & Raab, 2010; Garet, 2001; Guskey, 2003; Vasumathi, 2010). Working with and encouraging others, and sharing and comparing experiences (Richardson, 2003) on teaching a subject or lesson plan are useful for these programs (Desimone, 2009; Kimmel et al., 2007; Wayne et al., 2008).
Factors that categorize a professional development program as unsuccessful include insignificant content, a lack of planning, and a low amount of support given by the program (Lewis, 1991). Poor choice of candidates, instructors, or location can also lead to an unsuccessful program (Lewis, 1991).

2.3 Camp Reach

As previously mentioned, many colleges and universities are offering professional development programs for teachers. One such program is Camp Reach. Camp Reach is an example of a STEM (Science Technology Engineering & Math) summer program for girls and professional development program for middle school teachers specific to our project. Founded in 1997 at Worcester Polytechnic Institute (WPI), Camp Reach was initially funded by a grant from the National Science Foundation (NSF), Model Projects for Women and Girls (Demetry et al., 2009). The program selects 30 middle school female applicants to stay over-night at WPI for two weeks under the supervision of five Resident Advisors

(RAs). The program has three faculty and staff directors that instruct the RAs, six to nine Teaching Assistants (TAs) and three Middle School Teachers (MSTs) of how to coach the campers (Camp Reach, 2010).

2.3.1 Camp Reach Goals

Camp Reach aims for the campers to understand the different aspects of engineering through their camp experience. The different engineering aspects are:

- Engineering requires collaborative work in teams
- The engineering design process can be used to find creative solutions to the problems of individuals, organizations, communities, and societies
- Engineering requires excellent written and oral communication between individuals and groups
- Engineers apply knowledge in the areas of math and science (Camp Reach, 2010).

Camp Reach is designed for "girls to experience engineering as a social, collaborative 'people profession' that benefits from excellent communication and teamwork skills," (Demetry et al., 123, 2009). Goals and strategies of Camp Reach for its campers are shown in Table 2.

Camp Reach has a distinct set of goals for the middle school teacher (MST) participants. As a professional development program, Camp Reach aims for the teachers to:

- Gain a better awareness and understanding of engineering and the engineering process
- Learn new ideas of how to use the engineering cycle (problem solving) in their teaching
- Adapt some of the workshops or activities for use at their school

(Camp Reach: Because Life Needs Engineering, 2011)

These goals allow Camp Reach to have the potential of affecting more than the 30 girls that attend the camp. Ideally, the MSTs adapt some knowledge they gained through the program to apply in academic situations, such as classroom settings or intellectual conversations with colleagues or students.

2.3.2 Camp Design

The Camp Reach program is designed to be a fun-filled two weeks for the campers. Discovery Workshops are an integral part of the camp where WPI professors hold engineering lessons and activities for the girls each day. The MSTs also participate in the Discovery Workshops, mentoring the campers in assignments while gaining some ideas of activities that could be used in their classroom (Camp Reach, 2010). The Discovery

Table 2: Goals and Strategies of Camp Reach for its Campers (Demetry et al. 2009)

Goals	Strategies

Collaborative problem solving	Campers work on a service learning design project in teams where they address a problem of a non-profit organization. They solve this problem through teamwork, creativity, and the engineering design process.
Defining engineering as a socially helpful profession	Workshop topics show how engineers make a difference and the world a better place. Example topics are rehabilitation engineering, fire protection engineering, and biomedical engineering.
Hands on learning	Workshops are designed to be active, involving hands-on manipulation of many different materials and tools.
Prevalence of role models	The camp staff is chosen specifically to expose the girls to a wide range of positive female role models, including high school students who attended Reach as campers themselves, undergraduate and graduate students pursing engineering and science fields, STEM teachers, and practicing women engineers.
Building self-efficacy	Camp Reach seeks to build self-efficacy by providing the girls with multiple sources of efficacy information. Among the strongest sources is performance accomplishment, which Camp Reach fosters by supporting the girls in multiple design engineering challenges.
Sustaining contact	Camp Reach hopes to sustain the girls' interest in engineering by continuing contact and holding events with them during their high school years.

Workshops emphasize hands-on activities. Some workshop activities include designing tools to assist people, creating shoes, and producing dance pads (Demetry et al., 2009). The

workshop topics are chosen to demonstrate how engineers make a difference in the world and how STEM (Science Technology Engineering & Math) subjects are necessary to address problems that concern young people (Demetry et al., 2009).

Camp Reach participants work in teams on a service-learning design project for a non-profit organization. The goal for these projects is to have the girls use teamwork, creativity and the engineering design process to solve real problems. Each year the campers are broken into teams of ten and are coached by one of the MST participants. At the end of camp, the project teams present a professional report to their client, who in turn commits to implementing some of the girls' recommendations within a year. An example of a completed service-learning project is helping a daycare provider keep mulch from spilling out of a chain link fence. (Demetry et al., 2009)

To meet its goal of having prevalent role models, Camp Reach uses a wide range of teachers and Reach alumni to be role models for the girls. Teaching assistants, typically Camp Reach alumni currently in high school, assist the camp by monitoring the girls in the dormitories at night, escorting them from building to building, and providing the girls with good role models (Demetry et al. 2009). The MSTs do not stay overnight with the girls, creating more of an educator role for them at camp (Camp Reach, 2010; Demetry et al., 2009).

2.3.3 Middle School Teachers at Camp Reach

Camp Reach middle school teacher (MST) participants are all math, science, or technology teachers from school districts in Massachusetts that are interested in participating in a STEM (Science Technology Engineering & Math) professional development program. MST participants receive professional development points required by Massachusetts and are paid for coaching the girls during their two weeks at Camp Reach. During the camp the MSTs "help the girls meet specific goals for each day and facilitate the sharing of ideas" (Camp Reach, 5, 2010). The specific roles of the MSTs as listed in the "Camp Reach: Because Life Needs Engineering 2011" training manual are:

- Facilitating work of the design project teams
- Helping the campers stay on task
- Making sure each girl has a participating role
- Answering questions with guiding questions or suggestions about using a process
- Offering encouragement and advice to campers
- Informing Camp Reach's administrators when information is needed or when adjustments in the schedule need to be made

To help the middle school teachers meet their goals, Camp Reach has them attend an orientation. This orientation includes:

- Learning the goals of Camp Reach
- Defining the roles of each staff member
- Reading material that introduces and explains the engineering design process

- Discovering what design project they will be coaching at camp
- Lesson plans and some procedures for each workshop

(Camp Reach: Because Life Needs Engineering, 2011)

The teachers are expected to facilitate group work on the first day with fun icebreakers and team builders. Each day the middle school teachers, teaching assistants, and camp administrators meet to review the progress of each team, exchange advice, and make adjustments to the daily plans. After the daily review, the MSTs coach the campers through engineering lessons and their design project. The teachers "coach" the campers by fulfilling their roles as staff members as listed above (Camp Reach: Because Life Needs Engineering, 2011).

At the end of the camp, the goal is for teachers to come away with ideas for projects and teaching methods that can be used in their STEM curricula or with their colleagues. Also, since 2010 the teachers have been offered the opportunity to participate in STEM Saturdays, where they independently deliver a full day of engineering curriculum to 40 middle school girls. STEM Saturdays have the potential to influence "hundreds of middle school students, not just [30] campers" by allowing the teachers to apply what they learned from Camp Reach (Camp Reach, 5, 2010).

2.3.4 Effects of Camp Reach

Camp Reach goals for the seventh grade girls are proven to be well met in a 2009 longitudinal study. This study followed up on applicants and participants from the first five years of the program. Findings included that about 18.3% of Camp Reach alumnae who participated in the full Camp Reach experience chose engineering majors in college, compared to 2.9% in the control group of girls who applied to Camp Reach but were not drawn in the lottery and 9.8% WPI control group (Demetry et al., 135, 2009). That same study found that campers "'learn[ed] more about engineering'" and came away from the program with the confidence that they could become an engineer (Demetry et al., 124, 2009). Over one-fifth (21%) of participants in the study said that Camp Reach increased their interest in engineering (Demetry et al., 2009). The 2009 report concluded that Camp Reach has long-term positive effects on some of its campers (Demetry et al., 2009).

Although Camp Reach collects immediate evaluative data from MSTs that are used to make year-to-year adjustments in the program, no long-term effects of the program on the middle school teacher participants have been studied. This shortage of information makes it difficult to answer questions about the long-term effects of STEM summer programs, such as Camp Reach. One goal of Camp Reach is to have its MST participants take away some knowledge that they learned from Reach (WPI.edu, 2011). Now that there is a sample group of 45 MST participants, it is in Camp Reach's interest to see if the teachers have changed anything at all in their approach to educating in engineering. These changes could range from simply talking about engineering to physically implementing some of Reach's activities.

Chapter 3: Methodology

The goal of this project was to analyze if and how Camp Reach affected it's past middle school teacher participants in order to develop recommendations for strengthening Camp Reach as a professional development program. The specific areas of focus correspond to the following stated goals for the middle school teachers. They are as follows:

- Develop better awareness and knowledge of engineering to share with students and colleagues at their middle school
- Come away from the program with some ideas of how to use the engineering design cycle (problem solving) in their teaching
- Adapt some of the workshops or activities for use at their school

We established the following research objectives in order to achieve the project goal:

1. Identifying short-term effects of Camp Reach on the middle school teacher participants
2. Identifying long-term effects of Camp Reach on the middle school teacher participants
3. Developing recommendations for the improvement of Camp Reach

In this chapter, we discuss the methods that we took to assess the end-of-program evaluations and research the effects on the teachers through teacher interviews. Finally, we explain how we drew conclusions based on both sets of data to help improve Camp Reach.

3.1 Identifying Short-Term Effects of Camp Reach on the Middle School Teacher Participants

Camp Reach distributes a program evaluation survey at the close of camp to the middle school teacher (MST) participants who then complete the evaluation questions individually. The format of these questions is either open or closed form. The topics include the camp's atmosphere, the design projects, and teachers' experiences with engineering. These questions were the source of data for the short-term analysis. This gave insight into what the teachers' attitudes towards engineering were, as well as if they may continue teaching or learning about engineering outside of the camp. The data the surveys presented is studied on an annual basis to make yearly improvements to Camp Reach, but have never been analyzed collectively. We analyzed the data from these surveys with the following research questions in mind:

- What were the final thoughts the teachers had on Camp Reach?
- What were the departing thoughts of the teachers on the subject of engineering?
- Did the teachers plan to implement more engineering into their classrooms as a result of Camp Reach and how?

- Did the teachers plan to encourage other colleagues to learn more about and/or teach engineering?

We focused on the short-term evaluation questions related to these research questions. In the 15 years of Camp Reach, there have been 46 MST participants, however only 18 surveys were available. Of these surveys, 15 were filled out by females, and three were completed by males. This data pool was made of eight science teachers, nine math teachers, and one unreported.

For the closed form questions, statistics were used to organize and analyze the data. Closed form questions included the teachers' thoughts on if they planned to implement more engineering into their classrooms as a result of Camp Reach, and if the teachers planned to encourage other colleagues to learn more about and/or teach engineering. These questions asked the teachers to indicate their levels of agreement with various statements about the effects of the program. We used descriptive statistics, specifically the mean and standard deviation, which helped show the quantitative data in a simple way that also made it simpler to analyze (McMillian, 2006; Wholey et al., 2010). While this type of data is useful, quantitative data only gives us a general sense of satisfaction and intentions, but very little detail about exactly what the teachers' intentions were at the end of Camp Reach.

We used an inductive analysis approach, a form of qualitative assessment, to analyze the open form end-of-program evaluation data. Examples of these questions includes if the teachers plan to implement what they learned at Camp Reach into their classrooms next year, what they liked most and least about Camp Reach, and how the teachers' knowledge of engineering has changed as a result of Camp Reach, if at all. This approach is used on data that is open ended, and is characterized by reading through the data and noting common themes (McMillian, 2006; Thomas, 2006). Characteristics of this method are closely related to the constant comparison method, where each piece of information is compared and contrasted with others, and then grouped by similar thoughts (Pope et al., 2000). The first step of this process was to assure all the data files were in the same format, allowing for easy comparison (Thomas, 2006). Next, we read the raw data numerous times for detail (Pope et al., 2000; Thomas, 2006), writing down notes on each piece with their main ideas (McMillian, 2006). By the end of this reading, we were easily able to find themes (Thomas, 2006). From the themes, the evaluator then created categories, or codes, that encompassed these themes (LeCompte, 2000; McMillian, 2006; Schilling, 2006; Thomas, 2006), also known as descriptive coding (Wholey et. al, 2010). There are two levels to the themes that were seen: the upper level which was filled with themes that were found that focus on the objectives of the evaluation, and the lower level which includes additional themes that emerged from the data (Thomas, 2006). The categories were created to resemble the data as closely as possible (Schilling, 2006). Raw data was dissected based on the content on a phrase level, with some overlap (McMillian, 2006; Thomas, 2006).

These categories were then characterized using a coding approach. First, a code was assigned to each category (Thomas, 2006; Wholey, 2010). These codes consisted of two to four letters. Using the recommendation of McMillian and Schilling, about two-thirds of the way through the data, we checked the categories to see if the themes were remaining

constant (McMillian, 2006; Schilling, 2006). Subcategories were then added to each category (Thomas, 2006; Wholey et al., 2010), with each subcategory having its own new code. The subcategories were formed to show comparison as well as opposing points of view to the common theme (Thomas, 2006). According to McMillian and Thomas, the ideal amount of categories is between three and ten, but the appropriate amount of categories really depended on how many were needed to express the main themes in the data (McMillian, 2006; Thomas, 2006). If the number of categories exceeded eight, the data may have been seen as incomplete, the data for various categories may have been combined, or less important categories were disregarded (Thomas, 2006). Schilling states that a solid category consists of approximately six to twelve responses (Schilling, 2006). The final codes for all data can be seen in Appendix C. It can be seen that a total of nine major categories were created, with five of these containing subcategories. The number of subcategories remained between two and six.

We exercised this approach individually for each of the open form questions. Our categories for each question were then compared among one another to create final categories. This also allowed us to check the sorting process through independent parallel coding (Thomas, 2006). The independent parallel coding process included each of us categorizing the data individually, and then all three of us comparing our categories to compile a final set of categories (Schilling, 2006; Thomas, 2006; Wholey, 2010). The categories were then refined several times before completion. Patterns were then identified among the categories, helping to connect them through common themes (LeCompte, 2000; McMillian, 2006).

While this was a beneficial place to start research on evaluating the MST (middle school teacher) participants of Camp Reach to better the camp, there were limitations. There have been 46 different MST end-of-program evaluations of Camp Reach but only 18 completed evaluations were available. Contributing to this fraction of available surveys was a lack of storage of the past surveys, resulting in their inability to be found. While Annual Reports of Camp Reach were available, not all of the evaluation questions were stated on them, or did not include all answers from the evaluations. In addition, evaluations of the year 2002 and earlier had different formats, of which less of the questions were relevant than the newer evaluations. Finally, questionnaires and evaluations have their own limitations, including answers written according to what the evaluator thinks those in charge of the program would want to hear, as well as not having the opportunity to further query about answers given (McMillian, 2006).

3.2 Researching Long-Term Effects of Camp Reach on the Middle School Teachers

The second step of our methodology was to interview the middle school teachers (MSTs). The long-term effects on teachers may range from one to fifteen years. Some teachers that were interviewed participated up to 15 years ago while others took part in the program only a year or two ago. Research questions that framed the teacher interview questions were:

- What did the teachers learn about engineering from Camp Reach?
- In what ways, if any, are the teachers spreading their engineering related knowledge learned from Camp Reach outside of their classrooms?
- What Camp Reach activities, if any, did the teachers implement in their school?

3.2.1 Development of Interview Protocol

In order to obtain this information, in-depth interviews with past MST participants were conducted. We first created an interview script of 24 interview questions as seen in Appendix B. These questions were open ended, starting with icebreaker questions for the teachers to become comfortable with the interviewer. Several interview questions that were asked focused on experience, opinions, and knowledge acquired during Camp Reach. The majority of the interview questions were based on the intended MST goals of Camp Reach. To avoid bias, the wording of questions was carefully created (McMillian, 2006). The interview questions were refined multiple times to avoid bias. The team wanted to avoid asking questions that encouraged a certain type of answer. Misunderstood question bias was also avoided by having less wordy and easy to understand questions.

The first goal of Camp Reach for its MST participants was to develop a better awareness and knowledge of engineering to share with students and colleagues at their middle schools. Questions related to this goal focused on the teachers' knowledge of engineering as a career prior to and after Camp Reach. The purpose of the questions pertaining to this goal helped create a clearer explanation of how the teachers were educated on the topic of engineering while at camp.

The second goal for the teacher participants was to come away from camp with ideas of how to use the engineering design cycle in their teaching. In addition, the third goal for the MST participants of Camp Reach was to adapt some of the workshops or activities for use at their school. These goals were used to create interview questions, aligning each goal with multiple questions. For example, questions asked if and how the teachers have used the engineering design cycle or activities from Camp Reach in their classroom and how students respond to them. These interview questions were intended to provide us with a better understanding of what aspects of Camp Reach are effective and being incorporated into the MSTs' classrooms.

In addition to interview questions based upon the stated goals of Camp Reach for the middle school teachers, we also explored changes in teachers' attitudes about engineering. Interview questions pertaining to this were meant for us to understand if teachers have altered their attitudes or opinions of engineering as a result of Camp Reach. We also included questions about any common misperceptions of engineering as a career.

Before conducting interviews, we performed a pilot test with one of the current Co-Directors of Camp Reach. She provided us with responses similar to what she believed the

teachers themselves would answer. This helped us to determine the approximate time of the interview and any questions that needed refining. The interview script was then altered based on this feedback (McMillian, 2006).

3.2.2 Participant Recruitment and Study Sample

Past middle school teacher (MST) participants of Camp Reach were contacted with a formal letter by postal mail. The formal letter explained the purpose of our project and asked them to participate in an approximate one hour informal interview with our group. Interview questions were not provided to the participants ahead of time as this may have allowed them to prepare answers promoting Camp Reach, creating biased data. If we did not hear back from the teachers within a week by email or postal mail, a follow-up email that had similar content to the formal letter was sent. If we still had not heard back from teachers approximately one week after the first email, we sent another email giving them possible days and times that could work along with the basics from the original formal letter.

As seen in Table 3, 42 teachers were contacted. Of those 42 teachers, 17participated in an interview; there were two teachers that declined and seven teachers did not respond to any of our emails or postal mail. Finally, seven teachers responded to our emails but failed to schedule an interview with us, and nine teachers we could not contact because we did not have updated contact information.

Table 3: Numbers of Contacted and Responded Teachers

Total number of teachers contacted	42
Number of teachers who participated in interviews	17
Number of teachers who declined to participate	2
Number of teachers who did not respond	7
Number of teachers that responded, never scheduled an interview	7
Number of teachers we could not contact	9

3.2.3 Interview Procedures, Analysis Methods, and Limitations

Interviews were conducted over the phone, with the exception of one in-person interview. This decision was based on limited transportation and time. During the interviews, two group members were present: one member conducted the interview while the other took detailed notes of the participant's responses. Each interview was audio recorded by phone or computer to be uploaded to a private YouTube channel, accessible only for group members. The team member that was not present later listened to the audio recording and confirmed the written notes, as well as made any necessary additions.

The interview began with greetings and introductions of the individuals present at the session. After introductions, the interviewer explained how the interview was going to run,

including its length and the opportunity for the interviewee to conclude the interview at any time. We also explained to the participant that their answers would be kept anonymous in any published work and asked their permission to audio record the interview (McMillian, 2006).

Interview techniques that we used while conducting the interviews included probing, pausing, and voice tone. Interview probing allowed us to get more elaborate responses from the participants. Meanwhile, pausing allowed the participant to think before responding. Finally, voice tone enabled the participant to connect and feel comfortable with us. Our intent was to establish trust between us and the participant. Using these techniques allowed for our interviews to run smoothly (McMillian, 2006).

In our case, we had 17 interviews making up 20 typed pages of teacher responses. We posted our teacher interview files on the Internet through GoogleDocs for easy editing and sharing. This system made it easier for us to compile the 500+ interview responses into one large document. Once we created a large document, we converted all the data into multiple Microsoft Excel documents for easy viewing and analysis (Schilling, 2006; Wholey et al., 2010). Excel, recommended by some social science experts (Meyer & Avery, 2009), provided us an easy copying strategy for putting the data into visually pleasing tables. In the Excel documents we sorted the teacher responses by gender, the subjects they teach, and the year(s) that they attended Camp Reach. By sorting the interview responses by gender, subject, and year we were able to see different trends and themes in the data.

We utilized the same manual content analysis method that we used for the evaluation data to analyze the teacher interview responses. We read through the interview responses numerous times before developing categories for each question. We then refined the categories several times. Once comfortable with the categorization, we identified patterns among the categories, which helped connect them through common themes (LeCompte, 2000; McMillian, 2006). These patterns helped to create better category definitions (LeCompte, 2000).

Several limitations might have affected the quality of raw data available for analysis. A limitation was the different time windows that the teachers participated in the program. Some of the participants attended Camp Reach over ten years ago, while others had only a few years to reflect back on. Some study participants could not remember program details, which could be due to routine loss of memory or limited effects of the program. Our study was not able to distinguish between those two possibilities. Although we attempted to craft interview questions that would lead to honest answers, it is possible that respondents answer in a way they detected was socially desirable. (Research Methods: Data Analysis, 2004).

3.3 Developing Recommendations for the Improvement of Camp Reach

The final step of our methodology was to draw conclusions and make suggestions to Camp Reach. The research questions we kept in mind while doing this were:

- What are the gaps between the short term and long-term effects of Camp Reach?
- What can Camp Reach do to be a more effective professional development program?

We included as many supporting examples for our conclusions as we could, to highlight the richness of the original data (Elos & Kynas, 2008).

To develop suggestions for Camp Reach to improve as a professional development program (PDP) we purposely asked the teachers to identify characteristics of an effective PDP. As a follow up to this question, we asked the teachers how Camp Reach could become a better PDP. The answers to these questions helped us discover what the teacher participants generally look for in PDPs and how Camp Reach can satisfy any unmet expectations. To make suggestions to Camp Reach of how to better it as a professional development program (PDP), we also went back to literature that describes the characteristics of effective characteristics in PDPs. We looked for similarities and differences in the teacher interview responses of good characteristics of a PDP and what qualifies as an effective program. From our results we developed points applicable for Camp Reach to consider when planning the professional development portion of camp.

Chapter 4: Findings

Through the end-of-program evaluations and teacher interviews, we found several findings about the effects of Camp Reach on its middle school teacher participants. In this chapter, we first discuss the short-term effects of Camp Reach based off the closed form Likert scale questions, as well as open form questions from the end-of-program evaluations. We then present our findings of the long-term effects of Camp Reach on the teacher participants through answers from the teacher interviews. These findings will assist Camp Reach in becoming a more effective professional development program and developing further improvements to the program.

4.1 Short-Term Effects of Camp Reach on Middle School Teachers

There were 18 end-of-program evaluations of Camp Reach available, each filled out by middle school teacher (MST) participants. These evaluations provided us with findings about the short-term effects that Camp Reach had on its MSTs. In this section, quantitative data analysis first demonstrates the effectiveness of Camp Reach with the intention of increasing knowledge of engineering and bringing activities back to the classroom. Next, the different factors of what teachers learned about engineering as a result of Camp Reach will be discussed. Third, teachers stated specific activities, as well as different teaching methods that they planned to take from Camp Reach to apply to their classrooms. The overall concerns that the teachers had with Camp Reach, including time constraints and comments on staff training, are discussed next. Finally, we state a few specific suggestions mentioned by the MST participants.

4.1.1 Quantitative Data Analysis

The middle school teacher participants left Camp Reach believing that they participated in an educational and organized program. As shown in Table 4, all statements had an average above a three, meaning the teachers generally agreed with each statement. The fourth question, which regarded if Camp Reach left the teachers with a better understanding of engineering, displayed the largest variation in answers, evident in its standard deviation of 0.55. This was no surprise since this question also had the largest number of Neutral and Agree responses from the teachers. The questions regarding the organization of the camp, communication between staff and the ability of the teachers to adapt projects and workshops in their classrooms had the same mean score and standard deviation indicating that the questions had very similar responses. From these numbers, it can be seen that Camp Reach had a positive short-term effect on the middle school teachers in various areas.

Table 4: Teacher Evaluation Closed-Form Question Results

Evaluation Questions	Mean*	Standard Deviation
(A) The program ran smoothly and was organized	3.94	0.24
(B) During the camp program, there was good communication between staff members	3.94	0.24
(C) I learned a lot from being a Camp Reach staff member	3.88	0.33
(D) As a result of Camp Reach, I have a better understanding of engineering	3.28	0.55
(E) I will be able to adapt design project or workshop activities in my own teaching	3.94	0.24
(F) I have ideas from Camp Reach that I will be able to share with my colleagues who can apply them in their teaching	3.94	0.24

*These responses used a Likert scale with the following choices: Strongly Disagree (0), Disagree (1), Neutral (2), Agree (3), and Strongly Agree (4).

4.1.2 What Teachers Learned about Engineering

Teachers' responses to open-ended questions about what they learned at Camp Reach fell into two broad thematic areas: what they have learned about engineering, and how they plan to implement engineering activities into their classrooms. The complete coding scheme for all data from the end-of-program evaluations can be seen in Appendix C.

Teachers reported increased knowledge about engineering at the end of Camp Reach. Seven of the teacher comments regarding gaining engineering knowledge were vague and broad in content. Teachers stated things such as "I gained new knowledge and ideas..." and they liked "learning about engineering." More specifically, seven teachers referred to learning more about how engineering can be used and how much teamwork, brainstorming, and creativity is involved in engineering. Two teachers also left Camp Reach feeling that engineers are those who work to help improve and solve problems in society. Four teachers also noted how engineering is all about trial and error, problem solving, and the characteristics of being able to communicate with others in order to succeed. Another teacher stated that they now see evidence of engineering everywhere because of their new knowledge of engineering gained while at Camp Reach. In addition, one middle school teacher (MST) learned how other subjects are involved in engineering. They stated that "I loved seeing how the different types of science were integrated into technology and engineering." The MSTs also left Camp Reach with a better idea of the engineering design process. One teacher stated that the images and depictions Camp Reach provided of the engineering design process "was very clear and explains the engineering thought/design process well."

In terms of engineering as a career, many teachers said that they felt engineering is a much broader field than they initially thought, as well as being more exciting and creative. One teacher stated "I now realize that engineering is a field open to a wider variety of people that I had believed." Another teacher said that after Camp Reach, they saw engineering as less of a solitary profession and more of an interactive one. Other MSTs learned that the engineering career encompasses many different types of engineers and that engineering is a field "all about helping people solve problems," as stated by one teacher.

4.1.3 Teachers' Plans for Implementing Engineering Activities

Questions regarding if and how the teachers' planned to implement any engineering related activities into their classroom after returning from Camp Reach provided two major answers: that the teachers planned to implement general and specific activities done at Camp Reach into their classrooms, and that they also were going to change their teaching pedagogy.

At the end of the program, six teachers reported that they planned to implement some general activity from Camp Reach in their classrooms, while 31 comments made by teachers indicated the intentions of implementing specific activities done at Camp Reach. Eight middle school teacher (MST) participants stated that they hoped to use the engineering design process as part of their classrooms in the future. They stated various ways to accomplish this, including using the design process with a class project or alongside the scientific method. Two teachers also planned to use the decision matrices learned at Camp Reach in their classroom.

The teachers also indicated that they wanted to incorporate specific workshops done at Camp Reach. Fifteen different workshops were mentioned in total as being possibly brought to the MSTs classrooms. The most popular of these were the Design Project, Dance Pad, Wacky Shoes, and Forensics. Teachers felt that the Design Project could easily be brought to their classrooms and one teacher even mentioned possibly trying to work with a local organization to make this happen. Numerous teachers felt that the Dance Pad and Wacky Shoes activities were easily adaptable into their classrooms and would help show the engineering design process. One teacher stated that these activities "can be used in the classroom to introduce and use the design process and decision matrices."

Furthermore, eleven teachers also planned to change the way in which they teach as a result of Camp Reach. Some middle school teacher (MST) participants stated their goal of using research techniques learned at Camp Reach. One teacher stated that they will be "teaching less and facilitating more," while another said they planned to let the students redesign before giving them the answers. A different MST also said they were going to utilize the binder with activity ideas given to them at staff training. Two teachers also hoped to have their students work in groups more, saying that they will "use more group work."

4.1.4 Teacher's Feelings of Staff Training and Suggestions for Improvements

In addition to these findings, staff training was seen overall as a good preparation for Camp Reach and a good experience by the middle school teacher (MST) participants. Fourteen of the teachers comments felt that the staff training was well organized and provided them with enough material to help facilitate in preparing them for Camp Reach. Many teachers wrote comments demonstrating how the training made them well prepared to be involved in all activities at Camp Reach. Two teachers also mentioned how helpful the binders were that contained information about the activities done at Camp Reach.

Concerns that the MSTs referred to involving the staff training were that some teachers felt unprepared for Camp Reach. The general comments regarding not feeling prepared were all from the year 2002 except for one. This was the year that one of the co-founders of Camp Reach, Denise Nicoletti, passed away as that year's Camp Reach program was starting. Comments in this subcategory directly reference this incident. In addition, teachers of various years felt that more instruction and preparation on specific workshops was necessary. The most popular comments referred to needing more guidance on the Google SketchUp activity and the electrocardiogram workshop. One teacher commented that "the ECG workshop was a little confusing at first and if we had known the procedure, we could have been more helpful." Other comments stated that additional background and training on some activities would have benefited the teachers and therefore helped the girls more. Three middle school teachers also felt that the training was too lengthy, but these comments did not seem numerous enough to be taken into consideration.

Another theme that emerged in response to questions about improvements that could be made to the Camp Reach staff training and the camp in general was the challenge of time constraints in the program. Most of the comments addressing time constraints were in reference to the scheduling of the day. Four teachers wanted breaks from the students and down time to be put into their schedule. Another MST thought that time to meet as a group in the afternoon was needed, while three others wanted the girls to have breaks at certain parts during the day. Most comments were focused around ideas of how to change the scheduling of the day, some of which have been taken into consideration already. Four middle school teachers (MST) also felt that they needed more time with their fellow teachers. One of these teachers said that they needed "more time for the teachers to meet and discuss what is and isn't working."

The other portion of Camp Reach that the MSTs felt needed more time was specific workshops. Seven teachers broadly stated that they needed more time on the workshops in general, while one other teacher said that they felt rushed on certain activities, the Bridges and Rehabilitation workshops. Two MSTs suggested more time on their design project in return for other less important portions of the day, stating that "more time for some projects could be great, [and] less time in the cafeteria at lunch might be a good idea."

Upon leaving Camp Reach, two middle school teachers (MSTs) also felt that the general activities of Camp Reach contained some material that was unsuitable for the age group of the students, while four MSTs thought that the girls would have benefited from learning

lessons in a different way. One teacher stated that the topics of some workshops, such as the wavelength and frequency ones, were too off base with their knowledge. Another MST felt that presenters were using terms and ideas that the girls were also too young to understand. Three MST participants commented on making activities and labs more hands-on and interactive, instead of just lecturing. A few teachers also felt that Camp Reach made good use of diversity in planning activities and demonstrating the different types of engineering. Comments noted that the ability to experience different types of activities was well liked by the teachers and students.

There were a few suggestions on how to improve Camp Reach in general. A suggestion that was mentioned regarding organization was to possibly have the girls return to whichever type of engineering that they enjoyed the most on the last day of camp. Suggestions were also made to possibly select the campers themselves more carefully to avoid those who did not take full advantage of Camp Reach's opportunity. While most teachers felt that the teaching assistants (TAs) were also an enjoyable portion of camp, some felt that they needed to focus more on the campers and less on themselves and various activities.

The middle school teacher (MST) participants also provided substantial suggestions on how to improve specific workshops done at Camp Reach. These suggestions included spending more time on Biomedical Engineering, reworking the Rehabilitation workshop, and giving better separation of the portions in the Bridges workshop. Other teachers felt that the Unbirthday Party was not a good way to start the week, and that "a few of the workshops could be improved so it's clearer to the girls what the point of [them are]: Rehabilitation, Fire Safety and AM Radios."

4.2 Long –Term Effects on the Middle School Teachers

Analysis of the 17 teacher interviews brought about discoveries of long-term effects of Camp Reach on the middle school teacher (MST) participants. This section will first discuss three types of general knowledge that the MSTs gained from Camp Reach and misperceptions about engineering that the teachers are easily able to identify. Then, changes in teaching activities and methods due to Camp Reach will be addressed. Finally, the chapter will conclude with additional reflections on Camp Reach that may be relevant to help improve the program.

4.2.1 Knowledge About Engineering

Overall, the middle school teachers (MSTs) left Camp Reach with an increase of knowledge about engineering. Without prompting, only one of the 17 teachers volunteered that Camp Reach helped increase their knowledge of engineering. However, when asked, 14 of the teachers were able to explain ways in which their knowledge was enhanced. They expressed this enhancement by describing various engineering disciplines, engineering as problem solving, or increased familiarity with the engineering design process.

The interviewed teachers increased their knowledge about the different types of engineering fields during their stay at Camp Reach. The interviewed teachers commented a total of 24 times about their knowledge of engineering. Of the 24 responses, 11 of them specifically pertained to knowledge gained about the various engineering careers. Indication of Camp Reach's workshops impacting the MSTs' knowledge about the various engineering disciplines was found in other responses mentioning the teachers' prior limited awareness of the different engineering fields. One teacher, for instance, had said, "…when I came to CR, I realized that there are more branches and directions of engineering than I thought. All engineers are not the same." All responses mentioned a more general knowledge of the existence of different types of engineering careers.

The MSTs defined engineering as a collaborative process of testing and planning to create a workable design. Four of the 17 interviewed teachers referred to increased knowledge about the engineering design process. All four teachers agreed that they knew what the engineering design process was before Camp Reach, but are now more readily able to identify the process. Without prompting, two teachers stated that they are now able to teach an engineering unit with the design process in their class if time and their curriculum allows.

In the rest of this section we will discuss the specific misperceptions that the MSTs identified during their interviews. Many teachers explained misconceptions about engineering that they often encounter and try to clarify, including engineering is not for girls, engineering as a career, and that there is a "geek" factor in engineering perceptions. There were 42 comments regarding misperceptions in engineering, demonstrating that teachers are recognizing inaccuracies in knowledge about engineering among their students, parents of students, and peers. Eleven of the 17 teachers clearly identified the misperceptions they see in their classroom without being asked.

Some of the interviewed teachers recognized the misperception that engineering is not for girls: five of the 17 teachers identified this. These five teachers each recognized that there are not enough women in engineering and that young girls are not as inclined to explore engineering, for it is viewed as a strong and more masculine career. Interestingly, all three of the male interviewees acknowledged the lack of women in engineering. One had stated, "[since Camp Reach] I felt myself focusing on the girls more. I was trying to reach out to them more. During high school [students] start to segregate more, and there are not as many girls in the math and sciences. In middle school the number of strong males and females in these subjects are equal…I was positive about planting seeds [in] the girls about pursuing careers in math and science." Many of teachers mentioned that as a result of Camp Reach they tend to be more proactive in encouraging girls to pursue their interests in engineering, math, and science. Four teachers plainly stated that due to their experiences at Camp Reach, they feel themselves focusing more on their female students in the classroom.

Seven of the 17 teachers identified misperceptions about engineering as a career. Generally these seven teachers indicated that society sees an engineer as man in a white lab coat, and also commented on how false this representation is. For example, one teacher

stated, "…[generally] in science students have misconceptions of a male in a white suit…I took my students to Alden labs, where we did lab tests with water. They were surprised the professor didn't look a scientist. He was normal! I think that most people don't see engineers for what they really are." Also the interviews resulted in four of the 17 teachers asserting that their students viewed the engineering career as extremely difficult, and not within their intelligence level.

The final, most commonly mentioned misperception is related to a "geek factor" in engineering. Eight teachers confidently used "geek," "nerd," or "lab coat" when describing the misperceptions they see from their students. One teacher commented that to a degree this stereotype is true, and that engineers need to have a love or skill for science and math to succeed in their chosen field.

All 17 teachers said they clarify misperceptions about engineering when opportunities arise. They unanimously agreed that misperceptions in engineering are not topics they can teach to their students, but instead clarify when questions are asked. Only three of the teachers were unable to identify a misperception, or said that none exist in their classroom. Overall, the teachers believe that they cannot address misperceptions in engineering unless inquired about the careers by their students.

4.2.2 Teaching Activities and Teaching Methods

This section discusses the interviewed middle school teacher participants teaching activities and teaching methods that have been affected due to Camp Reach. First we will discuss the number of teachers that have used a Camp Reach activity in their classroom. Then we will elaborate on the teachers' most commonly favored camp activities. Next we will explain two teachers' uses of the engineering design process in their classroom, followed by the difficulty for them to include Camp Reach activities in their classrooms due to the Massachusetts and district curriculum standards. We will conclude this section with a discussion on how the teachers are more proactive in encouraging girls during science and math related activities.

A relatively small number of teachers cited a specific activity from Camp Reach that they utilized in their classroom. Five of the 17 interviewed teachers identified an activity that they have done in their classroom based on an activity done at Camp Reach. The 12 teachers that have not done activities expressed difficulties with incorporating Camp Reach workshops into their classrooms due to the subject they teach. These 12 teachers taught math, biology, or earth science and generally believed that camp activities were more relevant to a different subject.

The design project was the most commonly mentioned activity. Eight of the 29 comments relating to specific workshops mentioned the design project, saying that it was a great experience that the girls thoroughly enjoyed, giving them the opportunity to use the design process from beginning to end. Both Wacky Shoes and the Forensics Workshop were the

next most commonly mentioned activities. Both activities were mentioned five times in the teacher interviews, complimenting the level of camper engagement each generated. The five responses agreed that Wacky Shoes is a fantastic activity due to the amount of hands-on work involved.

Only two teachers identified that they are using the engineering design process in their teaching. One of these teachers is a science teacher, while the other is a math teacher who works together with a science teacher from their school to use the design process in a large project. The first teacher had their students use the engineering design process to create a Rube Goldberg machine: "We used the engineering process to create the Rube Goldberg machine. The students learned about energy and magnetism while their goal was to raise a flag. The activity was more about using the engineering design process." The second teacher tries to incorporate the design process into already existing projects that their students do, while at the same time satisfying the Massachusetts curriculum standards.

Multiple teachers explained that curriculum constraints make it difficult for them to apply engineering activities in their classroom. Eleven of the 17 teachers agreed that either Massachusetts or school district standards make it difficult to include any out-of-curriculum lessons. These 11 teachers also stated that engineering is not related closely enough to their educational objectives to cover it in their lessons. One math teacher plainly stated her required curriculum situation: "We have 44 educational objectives that need to be covered in 32 weeks. It's difficult to do that alone, never mind incorporating engineering. [My school] stresses high MCAS scores so much that I feel like I cannot include engineering in my classroom properly." Five teachers believed that their curriculum does not hinder their ability to include engineering in their classrooms, generally stating that curriculum restraints need to exist so that students are properly educated. Four of these five teachers have used Camp Reach inspired activities in their classrooms. One teacher who instructs at a private school reported no problems including engineering in her curriculum. Interestingly enough to note, two of the teachers interviewed recently moved from Massachusetts to another New England state. Both stated that their new states, Connecticut and Rhode Island, make it easier for them to include engineering in their classrooms due to more lenient state curriculum standards.

4.2.3 Teacher's Desired Professional Development Program Attributes

When asked what constitutes a good professional development program (PDP), the teachers identified characteristics that align with professional best practices discussed in Section 2.2.2. For example, eight teachers identified a ready-made lesson plan as one take-away from the program as a desirable PDP attribute. Three of these teachers again identified this key characteristic when asked how to improve Camp Reach as a PDP. These three teachers wanted an implementable lesson plan from Camp Reach, ready for their use at the start of school. Also characteristic of a good PDP, five teachers suggested a type of outreach system for Camp Reach to continue engaging its teacher participants in engineering related activities. One response example that suggested Camp Reach improves

upon both these characteristics was: “I’m not incorporating anything from CR into my classroom. For PDPs, I have attended a full day conference in Rhode Island where I looked for specific take-aways from the program that I can definitely incorporate into our program. We want things that we don’t need to alter a lot to use in our classroom.”

4.2.4 Teacher Reflections on Camp Reach

As a whole, the interviewed teachers were impressed with Camp Reach. Eight of the teachers specifically complimented the organization of camp, generally agreeing that “it was an invigorating experience.” Three teachers even complimented the effectiveness of Camp Reach as a professional development program without prompting. One such teacher said, “it was the first opportunity where I felt that you can integrate math and science in a fun, practical, hands-on way with just girls.” Another teacher mentioned that Camp Reach was her first stepping-stone in science and math professional development, and has been hooked on learning more about STEM ever since Camp Reach. Overall, the interviewed teachers greatly enjoyed their Camp Reach experience and were beyond impressed with the program.

Chapter 5: Conclusions and Recommendations

This study has shown that the professional development component of Camp Reach is successful in presenting engineering in a way that has increased the teachers' knowledge and experience with engineering, as well as helped some of the teachers bring engineering into their classrooms. In this chapter we first present conclusions about the impact on teachers' knowledge of engineering, changes in the classroom, and general effectiveness of staff training. Then we provide suggestions on program changes and activity changes to offer recommendations about improving Camp Reach as a professional development program and as a whole.

5.1 Conclusions

5.1.1 Impact on Teachers' Knowledge of Engineering

A goal of Camp Reach is that the middle school teacher (MST) participants leave the program with a new knowledge of engineering. Both the short and long term evaluations illustrated that the majority of the teachers left Camp Reach with a feeling that they had gained knowledge about engineering. Most comments noted that the teachers' increased knowledge of engineering was about engineering as a career. They now understand how many different types of engineering careers are available and that they can be exciting and collaborative. Other teachers stated an increased knowledge of the engineering design process. It was said several times that the engineering design process helps them see how the engineering thought-process works, and how easily a smaller number of MSTs can use it for many of their activities.

Another outcome of teachers' participation in Camp Reach was the ability to identify and explain common misperceptions about engineering. Three major misperceptions about engineering were indicated throughout the interviews with the MSTs. They are:

- Engineering is not for females
- Engineering is too difficult, or not a career for everyone
- All engineers are nerds or geeks

The MSTs are able to clarify these misperceptions in different ways. Many teachers stated that they give special attention to and encourage girls towards STEM (Science Technology Engineering & Math) involvement in regards to the first misperception. Some teachers have shown their students that the second misperception is untrue by explaining the different engineering careers that are available. Finally, teachers work to clarify the last misperception by showing how anyone can be an engineer.

5.1.2 Changes in the Classroom

After attending Camp Reach, the middle school teachers (MSTs) have changed some approaches towards teaching. Comments provided by the MSTs in the end-of-program evaluations showed that they planned to change some part of their teaching pedagogy because of Camp Reach. It was then seen that most of them followed through with this according to their interview responses. While the end-of-program evaluation responses of this type were scattered in precise content, the interview comments focused around the teachers now paying more attention to their female students and encouraging engineering, while also clarifying engineering misperceptions.

The long-term evaluations also showed that a small number of Camp Reach activities have been implemented into the middle school teacher (MST) participants' classrooms. General activities, including activities using engineering knowledge gained at Camp Reach, were noted as being used in the classrooms. Others commented that they have implemented the engineering design process into their classrooms after attending camp. Finally, the teachers talked most about putting specific workshops done at Camp Reach into their classrooms. Other teachers tried to incorporate these workshops into other lessons or focus areas being taught to save time and help integrate the subject of engineering into their classrooms. The specific workshops that were identified as being placed into classrooms include Wacky Shoes, Rockets, Bridges, the activity involving pH, the Ice Cream Sundae activity and Forensics.

The reasoning for many of the teachers who have not been able to implement activities or teaching strategies from Camp Reach into their classrooms is in part from the numerous curriculum standard restraints they face. A major conclusion that was drawn from the findings of the interviews with the MST participants was that the teachers must restrain their curriculum due to factors such as the state guidelines, state tests, and school expectations. Time was the major influence of all these factors. Almost all teachers who could not or did not implement engineering into their classrooms said that they just did not have time for it. Others stated that the MCAS (Massachusetts Comprehension Assessment System) standardized test forces them to spend time teaching subjects and concepts specific to this test, rather than other lessons.

Most of the past middle school teacher (MST) participants of Camp Reach were not engineering or technology teachers, but instead science and math teachers. This fact indicates that most have different state and school subject requirements than the technology and engineering teachers. The majority of the teachers were not required to incorporate engineering or technology in their classrooms. Many of these teachers' comments also stated that they have too much to cover in their own subject requirements. Others feel that engineering does not fit into their subject area, specifically the math teachers.

5.1.3 General Effectiveness of Staff Training

The Camp Reach staff training provided for the MSTs is meant to cover basic camp material, including how to work with middle school girls and how to facilitate the specific workshops, among other things. Comments on the end-of-program evaluations led to the conclusion that the staff training proved to be useful to the MSTs when experiencing Camp Reach. Many comments stated that the binders given to the teachers helped them greatly with the specific workshops, while others felt that the staff training covered everything that was needed and was well organized. The complaints about the staff training, including time constraints and feeling unprepared after completing the training, were made mostly in the early years of Camp Reach. Therefore, it can be said that Camp Reach has been gradually improving in regards to these comments.

5.2 Recommendations

5.2.1 Strengthening Camp Reach as a Professional Development Program

We provide the following recommendations to the directors of Camp Reach to strengthen its impact as a professional development program for teachers:

Reprogram camp activities to better fit with the Massachusetts curriculum standards: We discovered that although Camp Reach's middle school teacher (MST) participants have used ideas and knowledge gained by Camp Reach in their classrooms, they have yet to closely replicate camp activities easily as lessons for their students. To help the teachers duplicate Camp Reach activities, we recommend the directors to familiarize themselves with the Massachusetts curriculum to reprogram some camp activities to better fit into a Massachusetts classroom. In our interviews, the teachers unanimously agreed that curriculum restraints exist on the STEM (Science Technology Engineering & Math) topics they teach. The majority of teachers made it clear that the Massachusetts STEM frameworks are rigorous and packed with a multitude of educational topics students must be taught. The frameworks do not allow for long, drawn-out experiments or activities, due to the loss of hours on other topics. For this reason we suggest Camp Reach to familiarize itself with the curriculum to make camp activities more plausible to teach in the middle school STEM frameworks.

Provide teachers with lesson plans that can be implemented in a typical classroom schedule: MST participants are constrained by the frameworks and do not have time within their lesson plans to duplicate Camp Reach activities. In their interviews, teachers revealed that a Camp Reach activity would take much more time than they have to teach their students, and the activities do not aligned easily with the curriculum. We gauged that a Camp Reach workshop would take approximately a week's worth of science lessons to duplicate, based on the teacher responses. One of the most popular interviewed teacher suggestions regarded implementable lesson plans at the end of a professional development program (PDP). Since Camp Reach is a PDP, we suggest giving the MSTs a lesson plan they

can use in their classrooms based on a camp workshop or design project. This would give the MSTs a concrete example of how they can use engineering in their classrooms. Additionally, providing the teacher participants with a lesson plan is a characteristic of a good PDP (Dunst, 2010; Garet, 2001; Gerard et al., 2011; Guskey, 2000; Guskey, 2003).

Hire engineering and technology teachers so that camp activities can be more frequently brought to middle schools: Since Camp Reach activities are most applicable to the engineering and technology teacher framework, we recommend Camp Reach recruit more engineering and technology teachers. Camp Reach most commonly hires science and math teachers to coach the campers each year. Technology and engineering teachers are seldom hired, although the amount of technology teacher applicants is unknown. We learned that the Massachusetts framework often calls for the position of an engineering and technology teacher in middle school classrooms, depending on the school district. We believe that by hiring more technology and engineering teachers, Camp Reach activities would more likely be used in MST participant classrooms.

Continue practice of recruiting teachers from the same school or district: One of Camp Reach's goals is for the teachers to come away with ideas of incorporating engineering into their classrooms. One way of doing this is by recruiting teachers from the same school or district. A trend we could identify from two specific interviews was that teachers who were from the same school when attending Camp Reach implemented a specific workshop in both of their classes. We feel that this may mean that the teachers are more likely to use specific workshops from Camp Reach in their school or grade level if they are from the same school and are able to communicate efficiently. A majority of the teachers commented that having another teacher participate in the program with them from the same school or district would be helpful when thinking of ways to make use of the acquired knowledge from Camp Reach. An attribute of a strong professional development program is one that encourages teacher-teacher learning, which is a form of collective participation (Vasumathi, 2010). A strong professional development program also encourages teachers working with others and sharing experiences (Richardson, 2003).

Have MST participants promote Camp Reach to Massachusetts school teachers: Many of the teachers we interviewed recommended better promotion of Camp Reach. In order to continue the popularity and success of Camp Reach, we suggest the program to seek further promotion in Massachusetts schools. One teacher suggested having past MST participants go to Massachusetts middle schools and promote Camp Reach. Unprompted, two teachers volunteered to share their experience on behalf of Camp Reach. Both teachers believed that this would help encourage more teachers to apply to the program by giving them a general idea and feel of Camp Reach. A few of the interviewed teachers stated that having a peer promote the camp would be more welcoming than a representative from the program. We believe that a more active promotion of Camp Reach will result in more teacher applicants to the program. In turn, this will allow the program to choose the type of teachers it wants, whether they are math, science, or engineering-technology teachers. This will create a larger selection pool for Camp Reach to choose from, only bettering the quality of the program by hiring superb MST applicants.

Make camp-based activity kits as a promotional item for teachers to apply to Camp Reach: A final programming suggestion to promote more STEM teachers to apply to Camp Reach comes from a suggestion in a teacher interview. One interviewed teacher suggested Camp Reach to make traveling sample kits of the program. These kits would include enough materials to complete an entire activity, similar in style to a Camp Reach workshop. These kits could be sent to schools where teachers could try them in their classrooms or as an extra activity for ambitious students. The teacher who suggested this believed that this would generate more interest and excitement in teachers to apply to the program.

5.2.2 Additional Areas of Improvement for Camp Reach

Provide the MSTs with a 10 minute break before lunch: Another change we suggest making to the teachers' daily schedule at Camp Reach is to provide them with a break from the girls throughout the day. During the analysis of the short term evaluations, we found that since 2010 teachers have been asking for more personal time during the day. There were multiple comments regarding a much-needed break from students during Camp Reach daily activities. We recommend giving the teachers ten minutes before lunch to themselves. These ten minutes would be spent away from the campers, allowing the teachers to use their phones to check emails and make personal calls. We believe that this will fulfill their requests for a quick break during the camp day.

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Appendices

Appendix A: Teacher Participation Request Letter

100 Institute Road
Worcester, MA 01609
508-353-3373
iqpcampreach@wpi.edu

October 26, 2011

Participants First and Last Name
Street Address
City, State, Zip Code

Dear Mr./Mrs./Ms. Participants Name,

We are currently juniors at Worcester Polytechnic Institute completing our Interactive Qualifying Project (IQP). Our IQP is a requirement of graduation; it is essentially a project that is outside of the group members' majors that helps to build teamwork skills. The focus of our IQP is the past teacher participants of Camp Reach. The main goal of our project is to learn if and how Camp Reach is functioning as a professional development experience for middle school teachers. We will then make recommendations for the improvement of the program based on our findings.

With this in mind, we would like to please ask your assistance in obtaining information on your personal experience at Camp Reach. If you choose to participate, an informal interview via phone or Webcam will be set up according to your availability. The interview will be approximately one hour in length and will be audio recorded with your permission. All your responses provided during interviews will be kept anonymous when reported in our final data analysis and in future any published work. At any time during the interview, you may choose to end your interview without question.

If you would like to participate in an interview, please email iqpcampreach@wpi.edu by Monday November 7, 2011 with days and times that generally work for you. We will then be in further contact with you to work out an appropriate interview date and time. If we do not hear from you, we may follow up by email or phone within the next week, as these interviews must be completed within a short time frame. If you do not wish to be contacted further, please email us at iqpcampreach@wpi.edu stating this. All interviews for this project are greatly appreciated and are vital for the completion of our project.

We greatly appreciate any time and effort that you can lend us, and we look forward to hearing from you soon. Thank you.

Sincerely,

Brittany Dellasanta
Lauren D'Angelo
Nisha Patel

Appendix B: Interview Script

Us: Hello, this is (Brittany/Lauren/Nisha). Is (teacher name) available?

Teacher/transfer to teacher: Hi this is (teacher's name).

Us: Hello, This is (Brittany/Lauren/Nisha). We are extremely happy you have agreed to help us with our school project by participating in this interview. We would first like to go over how the interview is going to run and the specifics of it.

This interview will be approximately a half an hour in length, but you may choose to end the interview at any time. Your identity will be kept anonymous when describing responses in any published work. While both of us are present, only one of us will be asking the questions and participating in the interview. The other group member in attendance will be taking notes on your answer to the questions asked. With your permission, we would like to record the interview for later reference only by us. Do we have your permission?

Teacher: *Y/N*

1) Us: Ok so let's get started. First off, can you tell us a bit about your teaching experience, like how many years you have been teaching, and in what subjects?
Teacher Response

2) Us: So as a teacher at (insert school name), are you required to incorporate engineering or technology standards in your math/science classes?
Teacher Response

3) Us: (If yes to previous question) Do you know exactly what the requirements are?
Us: (If no to previous question) Does your school require other math/science teachers to incorporate engineering or technology standards?
Teacher Response

4) Us: (If yes to previous question) How do you go about meeting these requirements?
Teacher Response

5) Us: Is the MA curriculum hindering your ability to incorporate technology and engineering in your classes?
Teacher Response

6) Us: So what made you want to attend Camp Reach?
Teacher Response

7) Us: And when you think back to Camp Reach now, what do you remember about the experience?
Teacher Response

8) Us: (**Interviewer probing** if seemed interested and excited about previous question. Possible probing question to follow up would be…) Did Camp Reach have any effects on you?
Teacher Response

9) Us: (If not already answered) What was your knowledge of engineering, specifically engineering as a career, prior to Camp Reach, as well as after Camp Reach?
Teacher Response

10) Us: (If knowledge of engineering has changed) Did you apply your new knowledge of engineering after Camp Reach to your classroom?
Teacher Response

11) Us: (If yes to previous question) Can you give examples?
Teacher Response

12) Us: (If not already answered) Of all the exploratory workshops you saw while at Camp Reach, which did you think were the most effective, if any?
Teacher Response

13) Us: (If answered that one/any were effective) Do you recall adapting these, or any of the activities into your classroom?
Teacher Response

14) Us: (If answer no to previous question) What were the factors that influence this decision?
Us: (If yes to previous question) Have these activities affected your interactions with students, females in particular?
Teacher Response

15) Us: (If did adapt activities and answered yes to previous question) How do the students generally respond to you through these interactions?
Teacher Response

16) Us: Do you see any misperceptions, lack of understanding, or stereotypes about engineering among your students, their parents, or your colleagues?
Teacher Response

17) Us: (If yes to previous question and this question has not already been answered) What are they?
Teacher Response

18) Us: (If yes to previous question) Do you have opportunities to try to clarify these misperceptions?
Teacher Response

19) Us: (If yes to previous question) How do you go about doing this?
Teacher Response

20) Us: What other STEM professional development programs had you completed before and after Camp Reach?
Teacher Response

21) Us: (If have attended PDPs) What activities did you do at these programs?
Teacher Response

22) Us: (If have attended PDPs) What have been the characteristics of any strong professional development programs that you have attended?
Teacher Response

23) Us: (If have attended PDPs) Did you implement any activities from these professional development?
Teacher Response

24) Us: Do you have any suggestions for strengthening Camp Reach as a professional development program?
Teacher Response

Us: That concludes our interview. Thank you so much for your time. We greatly appreciate it.

Appendix C: End-of-Program Evaluation Codes

(ST) Staff Training

(GP) Good Preparation/Training Good/Well Organized

- (2007) I felt very prepared for all sessions where I played a leading role. When I was merely a facilitator, I learned as much as the girls! **ST- GP, IK**
- (2008) I felt well prepared. **ST-GP**
- (2004) I felt well prepared. **ST-GP**
- (2004) The staff orientation was well done, and I felt well prepared for camp. **ST-GP**
- (2005) I felt very comfortable with all aspects of the orientation and don't have any areas in mind that could use improvement. I liked the insert with info on "what you can do to prepare for the first day." The binder is especially helpful and detailed! **ST-GP**
- (2008) The staff orientation covered most everything and if not the sheets were in our binders, which helped us help the girls because we knew what we were doing. **ST-GP**
- (2004) All prior info was useful. **ST-GP**
- (2005) The orientation was very informative and I thought that it was done really well. **ST-GP**
- (2010) Training was thorough and organized in all respects. **ST-GP**
- (2004) The time was divided well to cover all important topics. **ST-GP**
- (2005) I think orientation was great. **ST-GP**
- (2005) Overall, I admit I have felt under prepared at times but at the same time, I'm not sure additional prep time is necessary. I have felt challenged to make sure our design sessions are productive and am satisfied with the overall prep. I really appreciate that Chrys has been so helpful and accessible along the way. **ST-GP**
- (2009) Training was good, but our group did not even get a glimpse of Math Moves during the RayTech presentation. **ST-GP, SW-ILP**
- (2003) The binder will be a great resource for introducing technology and engineering to several topics in my classroom. **ST-GP, TP**

(FU) Felt Unprepared for Camp

- (2002) Things would have went a little smoother with a little more guidance. **ST-FU**
- (2002) Due to the unfortunate circumstances, I felt the middle school teachers did not get as much guidance/information as they/we normally would have. **ST-FU**
- (2002) I didn't know what to expect some days (like "details" of the day) but I think we did the best we could. **ST-FU**
- (2011) Not knowing exactly what we were doing, but that's my own issue. **ST-FU**
- (2002) Due to the loss of Denise Nicolleti, the director, I feel there was much more insight and engineering background knowledge to be gained from the program. **ST-FU**

(TL) Too Long

- (2009) Staff orientation/training was very long however I don't see where any part of the training could be eliminated or abbreviated. **ST-TL**
- (2005) I think we didn't have to spend as much time as we did on orientation stuff. **ST-TL**
- (2004) Maybe we could split up the orientation so it takes 2 days instead of 1. **ST-TL**

(TC) Time Constraints

(ACT) Activities

- (2006) I wish we had the time to create a model-this would help us "see" our plans better and bring our separate tasks together. **TC-ACT**
- (2007) The time constraints on the workshops were very tight. **TC-ACT**
- (2006) Feeling rushed as we researched the problem. **TC-ACT**
- (2007) Time constraints for Bridges and Rehab Workshops=too rushed w/ activities. **TC-ACT**
- (2005) I just needed time to get to the ladies around me in order to feel confident as a team. **TC-ACT**
- (2006) Possibly incorporating time for construction of a model or prototype. **TC-ACT**

- (2007) Time allotments for workshops. **TC-ACT**
- (2007) Timing might be the only issue I would address immediately-more time for some projects would be great- less time in the cafeteria @ lunch might be a good idea. **TC-ACT**

(BD) Breaks/Downtime/Scheduling of Day

- (2007) Project scope led to frustration; in time constraints; Cattler Associates -communication "2" customers was confusing at times. **TC-BD**
- (2006) We didn't have any time in the afternoon to regroup as a team to discuss our project. **TC-BD**
- (2010) Teachers need a break-for me I needed 30 minutes in the afternoon to stay focused until 5 pm. **TC-BD**
- (2010) Two weeks is a long stretch-we have no opportunity to check email or make personal calls (lunch time proved a problem as people I was looking for were also at lunch). **TC-BD**
- (2009) There was no "down time" -I am not sure that this can be changed and would not prevent me from participating in the future but it was different from a typical school day. **TC-BD**
- (2008) I didn't like the fact that we did not get a real break from the students. I care a great deal about them, but need adult time. **TC-BD**
- (2005) At times I felt like I was abandoning my group at the end of the day when I went home. I was very disappointed to have missed the sand castle building. **TC-BD**
- (2009) The girls really need a snack at about 10:30am to recharge them. **TC-BD**
- (2005) The schedule was great, but some of the afternoon sessions seemed a bit long. Even if the girls were given a 5-minute break here and there it could make a difference in their overall attention span. **TC-BD**
- (2004) After break a fun lab activity would be good to wind up the day. **TC-BD**
- (2008) Give 10-15 minutes a day for teachers to brainstorm with one another/take a break. **TC-BD**
- (2011) The girls in my group needed breaks in the morning routine, but that was easily done within our group **TC-BD**
- (2004) Adjust the schedule so that more of the design project is completed earlier in the day when the girls are more focused. **TC-BD**
- (2005) Some of the afternoon sessions went a little long-- probably because they might have been in the morning last year. The afternoon session could end a bit earlier and the time could be used for some physical activity before dinner. While it is clearly not the point of the camp, I think it is important to emphasize physical fitness and exercise to young people today. As I have thought more about it, I think an AutoCAD session/tutorial would be valuable for the girls and they could certainly learn the basics in a 2-3 hour session. It would be fun for them to complete a project like designing the perfect tree house or game room taking into account various design constraints (specifications). They could diagram their design in AutoCAD. **TC-BD**
- (2004) Sometimes it was difficult for girls to focus later in the afternoon. **TC-BD**

(TWT) Time With Teachers

- (2010) Plan for MST/TA time to touch base for 10 minutes before 9 am session begins. **TC-TWT**
- (2004) Somehow allow more time for the teachers to meet and discuss what is and isn't working. **TC-TWT**

(SW) Specific Workshops

(ILP) Unclear Instruction/Level of Preparedness

- (2009) To give more detail on the workshops and what to expect, so that we could give the students a little more guidance (in reference to the forensics workshop). **SW-ILP**
- (2007) Rehabilitation-I was unaware that I would be running the activities and did not have clear instructions for equipment. **SW-ILP**
- (2010) I would have benefited from GoogleSketch-Up training; I caught on quickly but would have been able to help campers had I been familiar with the program. **SW-ILP**
- (2010) Advance guidance on Google Sketch-Up with an exploratory activity would be helpful. **SW-ILP**
- (2004) The ECG workshop was a little confusing at first and if we had known the procedure we could have been more helpful. **SW-ILP**

- (2005) The electrocardiogram lab did not run as smoothly as I had hoped. I do not think the girls got the main point of this lab. Additional direction would have been helpful. The lab sheet also had a few typos that made some questions confusing for the girls. **SW-ILP**
- (2005) In both the biomedical engineering workshops, particularly the ECG one, staff wasn't required to participate; however it would have been extremely beneficial to have had more background knowledge of lab to assist the girls because they needed it. **SW-ILP SW-SUG**
- (2008) I was completely unaware that Jason would be there or that he would be the one operating the machine. I had to explain everything to the girls while he operated the machine and I expected the opposite. **SW-ILP**
- (2002) Denise gave us a brief overview of workshops-it was difficult to follow because we were not in the lab viewing the instruments she was talking about-visual aids would have helped or a run through of the actual workshop if possible. **SW-ILP**
- (2009) Training was good, but our group did not even get a glimpse of Math Moves during the RayTech presentation. **ST-GP SW-ILP**
- (2004) Most of the workshops didn't really need help from TAs, and for some of them we had no idea what was going on, however. **SW-ILP**
- (2011) The only part that I did not particularly enjoy was the Sketch-Up because I felt less prepared than I usually am. Frustration is part of learning, but when dealing with kids I'd rather be able to help them with their frustrations-I felt ill prepared and not much help. **SW-ILP**
- (2010) Improve quality of lab assistant teaching/explanations on bone-breaking activity. **SW-ILP**
- (2010) Please be sure to have instructors be clear about the purpose and outcome of each activity. **SW-ILP**
- (2007) Background knowledge of area for design project (i.e. not so much time hiking trails). **SW-ILP**
- (2011) More training for the Sketch-Up section. **SW-ILP**
- (2011) More clarification in the environmental detective activity, which was great. **SW-ILP SW-IA-EVE**
- (2004) Make sure teachers and TA's have copies of all the activity/worksheets the campers will be completing during the workshops ahead of time so that they can be properly.

(IA) Implement Activities

(RL) Radii Lab

-(2003) Using the radii lab...will try to emphasis engineering more along with WEIS and WPI. **SW-IA-RL GA**

(BR) Bridges

- (2007) I will be using the major design project with my seniors this year to decide on a placement for the PicturePost @ Voke. I will lead up to this using the Wacky Shoe and Bridge activities. **SW-IA-MDP SW-IA-WS SW-IA-BR**

(MDP) Major Design Project

- (2007) I will be using the major design project with my seniors this year to decide on a placement for the PicturePost @ Voke. I will lead up to this using the Wacky Shoe and Bridge activities. **SW-IA-MDP SW-IA-WS SW-IA-BR**
- (2005) I really enjoyed thinking in terms of "specs" -the engineering design process to perhaps work with a class on a larger design project -I would use the ice cream sundae activity. I hope to learn more about all the robotics opportunities to get kids involved in. I'd take a class to Bose-great tour! The Wacky Shoes design process was really great too. **GA-DC SW-IA-MDP SW-IA-WS**
- (2008) I enjoyed working on the design project with the campers. The workshops were great and we (campers and I) enjoyed them. Although each step in the engineering process was described and discussed, there were times that I was concerned if our team was on track. As it turned out, the team did well and had a very positive experience. **SW-IA-MDP GA**
- (2010) Working with the girls on their design project and seeing their excitement during the workshops. **SW-IA-MDP CW-GIR**
- (2005) My design project group was awesome. I am not sure I have ever worked with a group that worked together, supported one another, and completed assigned tasks as well as this one did. I really enjoyed working with my group and the time flew. **SW-IA-MDP CW-GIR**

- (2005) I enjoyed working with my team and helping them gain confidence in their abilities to research, write, interview and present. I felt it was really powerful for the girls to start and finish a really tangible project in 2 weeks and enjoyed the challenge of trying to get them through the process. **SW-IA-MDP CW-GIR**
- (2004) I might consider partnering with a local organization as a result of working on the design project. **SW-IA-MDP**

(SUN) Sundae Specifications

- (2009) Sundae Specifications will be used to help students see the importance of "show or explain" in an open response question. **SW-IA-SUN**

(DP) Dance Pad

- (2010) May offer Dance pod or wacky shoes as field day activity-robotics demo would be great but would it be possible? **SW-IA-DP SW-IA-WS SW-IA-ROB**
- (2009) Activities such as wacky shoes, dance pad mania and snack attack can be used in the classroom to introduce and use the design process and decision matrices. **SW-IA-WS SW-IA-DP SW-IA-SA**
- (2011) Because of my previous experiences with camp reach, my interest in engineering has been incorporated as much as possible for the past 8 years. I have done the dance pad workshop and the environmental detectives which I intend to steal...errr...borrow! **IK SW-IA-DP SW-IA-EVE**
- (2009) Activities such as Wacky Shoes, Dance Pad Mania and Snack Attack can be used in the classroom to introduce and use the design process and decision matrices. **SW-IA-WS SW-IA-DP SW-IA-SA GA-DC**
- (2010) How well organized this program is, leadership of Chrys Sue and Audra, getting to know my colleagues better, the TAs, learning about engineering, forensic workshop, Dance Pad Mania and Wacky Shoes. **CW-ORG CW-COL CW-TA IK SW-IA-FRN SW-IA-DP SW-IA-WS**
- (2010) Shoes and Dance Pads really got the kids excited and involved in the engineering process-both were based in real-life experiments for the girls. **SW-IA-WS SW-IA-DP**

(SA) Snack Attack

- (2009) Activities such as wacky shoes, dance pad mania and snack attack can be used in the classroom to introduce and use the design process and decision matrices. **SW-IA-WS SW-IA-DP SW-IA-SA GA-DC**

(ROB) Robotics

- (2010) May offer Dance pod or Wacky Shoes as field day activity-robotics demo would be great but would it be possible? **SW-IA-DP SW-IA-WS SW-IA-ROB**
- (2007) I would also like to start a "science club" and would like to utilize Bose and Ken to see if outreach (robotics) would be possible. **SW-IA-ROB**

(WS) Wacky Shoes

- (2007) I do joint projects with our TechEd teacher and Wacky Shoes will be our first suggestion. **SW-WS**
- (2010) May offer Dance pod or Wacky Shoes as field day activity-robotics demo would be great but would it be possible? **SW-IA-DP SW-IA-WS SW-IA-ROB**
- (2006) Wacky Shoes would be easily adaptable to my classroom: -measuring, scale drawing and the engineering design process is going to become a structure for activities to help my students better understand the engineering design process. **SW-WS GA-DC**
- (2007) I will be using the major design project with my seniors this year to decide on a placement for the PicturePost @ Voke. I will lead up to this using the Wacky Shoe and Bridge activities. **SW-IA-MDP SW-IA-WS SW-IA-BR**
- (2009) Activities such as Wacky Shoes, Dance Pad Mania and Snack Attack can be used in the classroom to introduce and use the design process and decision matrices. **SW-IA-WS SW-IA-DP SW-IA-SA**
- (2005) I really enjoyed thinking in terms of "specs" -the engineering design process to perhaps work with a class on a larger design project -I would use the ice cream sundae activity. I hope to learn more about all the robotics opportunities to get kids involved in. I'd take a class to Bose-great tour! The wacky shoes design process was really great too. **GA-DC SW-IA-MDP SW-IA-WS**

- (2008)...The organization and implementation of the workshops can be helpful in other similar workshops. I particularly liked the wacky shoes workshop. Learning how something is made and then creating your own is both educational and fun. **GA SW-IA-WS, IK**
- (2006) I will use the engineering design process next year-I think it is a good approach to any project. I could probably recreate the wacky shoes lab for my classroom. **GA-DC SW-IA-WS TP**
- (2010) How well organized this program is, leadership of Chrys Sue and Audra, getting to know my colleagues better, the TAs, learning about engineering, forensic workshop, dance pod mania and wacky shoes. **CW-ORG CW-COL CW-TA IK SW-IA-FRN SW-IA-DP SW-IA-WS**
- (2010) Shoes and dance pads really got the kids excited and involved in the engineering process-both were based in real-life experiments for the girls. **SW-IA-WS SW-IA-DP**

(FRN) Forensics

- (2005)... For forensics I wasn't too familiar with the building since I had only been on the first floor for orientation. **SW-IA-FRN**
- (2004) For all of the workshops except Forensics, we did not need much preparation in the topic. The instruction packet for forensics was very helpful. **SW-FRN**
- (2010) I like the forensic activity and will try staging my own. I am also interested in the green roof and growing some of these plants in my classroom. **SW-FRN**
- (2006) The engineering design process is a wonderful fit with the scientific method. I would like to use some of the research techniques in my classes as well as the Forensics activity. **GA-DC TP SW-IA-FRN**
- (2010) How well organized this program is, leadership of Chrys Sue and Audra, getting to know my colleagues better, the TAs, learning about engineering, forensic workshop, Dance Pad Mania and Wacky Shoes. **CW-ORG CW-COL CW-TA IK SW-IA-FRN SW-IA-DP SW-IA-WS**

(GSU) Google Sketch Up

- (2010) I may introduce Google Sketch-Up to my students for them to use in a project called My Dream Space where they make a scaled drawing of a complex-figure-shaped room. **SW-IA-GSU**

(COG) Center of Gravity

- (2005) There are many items that I will share with other teachers at school, especially science. The graphic of the Engineering Design Process was very clear and explains the engineering thought/design process well. Some of the labs could be useful supplements to our curriculum at school like the Crystal radio and the center of gravity. **GA-DC SW-IA-COG SW-IA-CRY**

(EVE) Environmental Engineering

- (2010) I would like to make the connection between Earth as a system and how environmental engineers work within that or those systems. **SW-IA-EVE**
- (2011) Because of my previous experiences with camp reach, my interest in engineering has been incorporated as much as possible for the past 8 years. I have done the Dance Pad workshop and the environmental detectives which I intend to steal...errr...borrow! **IK SW-IA-DP SW-IA-EVE**
- (2011) I will certainly be adding the biomedical engineering and the environmental engineering activities into my curriculum! **SW-IA-BME SW-IA-EVE**

(BME) Biomedical Engineering

- (2011) I will certainly be adding the biomedical engineering and the environmental engineering activities into my curriculum! **SW-IA-BME SW-IA-EVE**

(CRY) Crystal Lab

- (2005) There are many items that I will share with other teachers at school, especially science. The graphic of the Engineering Design Process was very clear and explains the engineering thought/design process well. Some of the labs could be useful supplements to our curriculum at school like the Crystal radio and the center of gravity. **GA-DC SW-IA-COG SW-IA-CRY**

(BUI) Building

- (2003) Building was great. SW-IA-BUI

(SUG) Suggestions

- (2006) The girls would love to be able to design their own robot. **SW-SUG**
- (2003) More emphasis on BME-we already know that's what girls like! **SW-SUG**
- (2008) Discuss other activities of the Cape besides castle building. Make sure the TA are clear on the building a circuit project. **SW-SUG CW-TA**

- (2006) The field trip to Bose and see if you can get some hands-on activities included in the trip. **SW-SUG**
- (2006) I'm not sure how effective the field trip to Bose was for the girls-I think the best part of the trip for the girls was the exposure to women in important job roles-the trip could be made better if there were more hands on activities, rather than a tour of the facility. **CW-EOG SW-SUG**
- (2007) Revamping Diability workshop-less lectures, more direct environment. **SW-SUG**
- (2005) In both the biomedical engineering workshops, particularly the ECG one, staff wasn't required to participate; however it would have been extremely beneficial to have had more background knowledge of lab to assist the girls because they needed it. **SW-ILP SW-SUG**
- (2007) Bridges-need more specific brainstorming/building separation. **SW-SUG**
- (2004) Reiterate how many girls will take the Forensics very seriously (because I didn't believe Stephanie, Val, and Chrys in the orientation). **SW-SUG**
- (2010) Biomed engineering and rehab engineering (disliked). **SW-SUG**
- (2005) Unbirthday party-Not sure how else to begin the week but this felt like a tough, slow start. Roles of TA's-More emphasis in training about how to facilitate discussion with 7th grade girls w/o giving them the answers-plus how they can be an asset during the project design process. **SW-SUG CW-TA**
- (2007) Rehab workshops=too much lecture. **SW-SUG**
- (2005) For the most part, I enjoyed everything. A few of the workshops could be improved so its cleaner to the girls what the point is of rehab, fire safety, and AM radios. **SW-SUG**

(GA) General Activities

- (2008) Wonderful workshops. **GA**
- (2008)...The organization and implementation of the workshops can be helpful in other similar workshops. I particularly liked the wacky shoes workshop. Learning how something is made and then creating your own is both educational and fun. **GA, SW-IA-WS, IK**
- (2003) Using the radii lab...will try to emphasis engineering more along with WEIS and WPI. **SW-IA-RL, GA**
- (2007) All these projects would be very appropriate in my classroom. **GA**
- (2009) We will use several of the projects this at school. **GA**
- (2010) I'm hoping to come up with some design and build activities that require measurement of length, area, volume, angles-some or all. **GA**
- (2008) In my new position as Educational Specialist and Advocate for Homeless Children I will design workshops on science. The director said the kids have been asking for more science activities. **GA**
- (2004) I can reference projects and workshops. **GA**
- (2011) I will have students decide the best possibility for a container with materials on a budget-they can calculate the best size, material, cost. **GA**
- (2005) To begin with the ice breaker and brainstorming resources will come in extremely handy! I learned a lot of games and songs I didn't know. Also, the decision matrix and task planning sheets will be useful to many of my 7th graders. **GA, TP**
- (2009) Camp reach has provided me with wonderful information and experiences that I can bring back and initialize in my classroom. **GA**
- (2004) Show students that there are real applications that can come of their work. **GA**
- (2004) There has been talk about getting our students involved in a science fair, and the concept of using the engineering problem solving approach may help students come up with ideas for projects. **GA**
- (2009) The motivated girls and great projects were the best. **CW-GIR, GA**
- (2008) I enjoyed working on the design project with the campers. The workshops were great and we (campers and I) enjoyed them. Although each step in the engineering process was described and discussed, there were times that I was concerned if our team was on track. As it turned out, the team did well and had a very positive experience. **SW-IA-MDP, GA**
- (2010) Love the hands on workshops and the real life project on sound tooth. **GA**
- (2010) I wonder if you took the kids through the different types of engineering and lead one day where they could go back to the area they were most interested in. **GA, CW-ORG**

(DC) Engineering Design Cycle

- (2006) Wacky Shoes would be easily adaptable to my classroom: measuring, scale drawing and the engineering design process is going to become a structure for activities to help my students better understand the engineering design process. **SW-WS, GA-DC**
- (2005) There are many items that I will share with other teachers at school, especially science. The graphic of the Engineering Design Process was very clear and explains the engineering thought/design process well. Some of the labs could be useful supplements to our curriculum at school like the Crystal radio and the center of gravity. **GA-DC, SW-IA-COG, SW-IA-CRY**
- (2005) I really enjoyed thinking in terms of "specs" -the engineering design process to perhaps work with a class on a larger design project -I would use the ice cream sundae activity. I hope to learn more about all the robotics opportunities to get kids involved in. I'd take a class to Bose-great tour! The wacky shoes design process was really great too. **GA-DC SW-IA-MDP SW-IA-WS**
- (2006) The engineering design process is a wonderful fit with the scientific method. I would like to use some of the research techniques in my classes as well as the Forensics activity. **GA-DC, TP, SW-IA-FRN**
- (2006) I will use the engineering design process next year-I think it is a good approach to any project. I could probably recreate the wacky shoes lab for my classroom. **GA-DC, SW-IA-WS, TP**
- (2009) Activities such as wacky shoes, dance pad mania and snack attack can be used in the classroom to introduce and use the design process and decision matrices. **SW-IA-WS SW-IA-DP SW-IA-SA GA-DC**
- (2009) I plan on introducing the engineering design process and offer an activity that enables students to connect it to a process for solving math problems. **GA-DC**
- (2008) I can use the engineering design process in a variety of activities, whether the activity is strictly math or a team related problem. **GA-DC**
- (2007) My understanding of the design process is much more sound now and I have a larger toolchest of activities to use to teach it. **GA-DC**
- (2008) I have learned a great deal about engineers and the engineering design process. All the steps from gathering information to interpersonal communication are important to succeed in solving a problem. **IK, GA-DC**
- (2008) I see the correlation between the engineer design process and the scientific method. I think more emphasis should be made to all as to how similar they are. I think this will benefit all. **GA-DC**

(CON) Content

- (2003) Exploration above their leads-in the 6th grade, they've no idea about wavelength and frequency. **GA-CON**
- (2009) Some conversation with presenters about using language that is age appropriate for the age group would be beneficial in increasing camper comprehension of material age appropriate language in presentations. **GA-CON**
- (2010) Campers need to know the objective of each activity and its relevance to the engineering process. **GA-CON**
- (2005) Maybe a little more "get to know you" time but I know how jam packed the schedule was anyways without adding more…Also, more active activities might help. **CW-ORG, GA-CON**
- (2003) Some of the labs were too "lecture-like"-most are hands-on and very educational; if the campers are listening to a speaker far too long, they lose their focus. **GA-CON**
- (2010) Making more of the workshops hands-on (and less lecture-e.g. green roof, rehabilitation eng). **GA-CON**

(DIV) Diversity

- (2002) Liked the mixture of learning and fun activities. **GA-DIV**
- (2004) Offered a wide range of activities that were appealing to girls with diverse interests. **GA-DIV**
- (2007) The diverse tasks and group work were fantastic. **GA-DIV**

(ORG) Organization

- (2004) I would suggest that in the future all the materials for the workshops, background information, as well as activity/worksheets, be given to staff beforehand. **GA-ORG**

-(2004) I would have liked to have been able to participate more fully in the workshops. Seemed more like policing than participating. **GA-ORG**

(EC) Engineering as a Career

- (2006) The girls were shown so many different kinds of engineering. **EC**
- (2007) Camp Reach reminded me that engineering is all about helping people solve problems. **EC**
- (2010) I appreciate engineering as a more interactive, people oriented career than ever before. I used to think of engineering as a more solitary profession. **EC**
- (2004) I realized there is so much more to engineering than office jobs and building things, and I learned how this can be expressed to students. **EC**
- (2004) I realized engineering is a broader and more pervasive field, and it is a place where women can and should make their voices heard. **EC, IK**
- (2005) I feel much more confident in my understanding of what engineering is and the multitude of jobs that engineers can have. I had no idea how exciting a career in engineering could be. **EC**
- (2009) I now realize that engineering is a field open to a wider variety of people that I had believed. **EC**
- (2005) The Camp Reach program was very valuable to me because it helped me understand why I went into engineering in the first place. In theory, I love engineering. Unfortunately, I did not find engineering to be as creative and exciting in practice. I have been hesitant to encourage young people to enter some engineering fields recently, and now have a new perspective. Thank you! **EC**
- (2005) I wish I had gone to Camp Reach! I think at the girls' age, I would have loved it and would have turned me on to engineering as a career. I feel like I have a significantly greater appreciation for engineering and can be a strong advocate for the field to kids. **EC**
- (2009) I may be more apt to encourage a broader range of students to learn about engineering now. **EC**

(IK) Increased General Engineering Knowledge

- (2007) I felt very prepared for all sessions where I played a leading role. When I was merely a facilitator, I learned as much as the girls! **ST- GP, IK**
- (2011) Because of my previous experiences with camp reach, my interest in engineering has been incorporated as much as possible for the past 8 years. I have done the dance pad workshop and the environmental detectives which I intend to steal...errr...borrow! **IK, SW-IA-DP SW-IA-EVE**
- (2008)...The organization and implementation of the workshops can be helpful in other similar workshops. I particularly liked the wacky shoes workshop. Learning how something is made and then creating your own is both educational and fun. **GA, SW-IA-WS, IK**
- (2010) How well organized this program is, leadership of Chrys Sue and Audra, getting to know my colleagues better, the TAs, learning about engineering, forensic workshop, Dance Pad Mania and Wacky Shoes **CW-ORG, CW-COL, CW-TA, IK, SW-IA-FRN, SW-IA-DP, SW-IA-WS**
- (2005) I enjoyed gaining a more broad understanding of engineering. I enjoyed working with a competent and friendly staff. I enjoyed meeting some great girls and having a lot of laughs while we worked towards a common goal. **IK, CW-COL CW-GIR**
- (2006) How much we learned and the different ways engineering is used. **IK**
- (2007) Engineering is not scary and abstract. It is a process of solving peoples' problems - finding a need and trying different methods to solve that need. **IK**
- (2010) Before 1997 I didn't really know what engineering was about. Based on that experience, I created a middle school course in engineering and got involved in an ECE research project and a materials science fellowship at Umass Amherst. **IK**
- (2009) I gained new knowledge and ideas that I can use in my classroom new knowledge of eng that can use in class. **IK**
- (2008) I have learned a great deal about engineers and the engineering design process. All the steps from gathering information to interpersonal communication are important to succeed in solving a problem. **IK, GA-DC**
- (2006) My attitude about engineering completely changed-before the camp, engineering sounded very boring, now it seems exciting and limitless! **IK**
- (2009) Camp reach rejuvenates my interest in engineering and tech! I love teaching, but this experience makes me long to teach and work as an engineer. **IK**

- (2008) I never really appreciated all the types of engineering required to produce anything. I also appreciate the role that redesign, teamwork and communication plays in engineering. **IK**
- (2011) I learned a few new things during environmental detectives. I thought of engineering before as a lot of calculations, now I see that it also involves brainstorming, trial and effort, etc. **IK**
- (2010) When I first started I really didn't know much about the design process or engineering at all, now I see evidence of engineering everywhere. We really can't live without it. **IK**
- (2010) Well-it helped me to realize that women have preconceived ideas about engineering-me too! However, the NERD factor does still apply. **IK**
- (2011) I loved seeing how the different types of science were integrated into technology/engineering. **IK-NVE**
- (2008) I love the fact to learn about what new and up and coming in science/engineering. I liked the consistency of math but I like the fact that science/engineering is every changing. **IK-NVE**
- (2004) I realized engineering is a broader and more pervasive field, and it is a place where women can and should make their voices heard. **EC, IK**

(TP) Change in Teaching Pedagogy

- (2006) The engineering design process is a wonderful fit with the scientific method. I would like to use some of the research techniques in my classes as well as the Forensics activity. **GA-DC, TP, SW-IA-FRN**
- (2006) I would like to use some of the research techniques in my classes. **TP**
- (2008) Camp Reach demonstrated how students learn best from one another. Therefore I will be teaching less and facilitating more. **TP**
- (2007) I plan on making my assignments more interactive, will use more group work, and will try (given obvious constraints) to use more technology with my class. **TP**
- (2011) I need to give them more of a chance to redesign. **TP**
- (2006) Getting to work with motivated young women was exciting and inspiring-this helped me to develop skills in inspiring them. **CW-GIR, TP**
- (2006) Engineering continues to weave its way into how I structure my classrooms; it is so much a part of our lives that I want my students to be made aware of how they could be a part of this. **TP**
- (2006) Yes-seeing the link between the topics I teach and the range of topics covered here was very enlightening enlightened to see connection btw topics at Reach and in classroom. **TP**
- (2003) The binder will be a great resource for introducing technology and engineering to several topics in my classroom. **ST-GP, TP**
- (2010) I will use some of the grouping techniques, the decision matrix. **TP**
- (2005) To begin with the ice breaker and brainstorming resources will come in extremely handy! I learned a lot of games and songs I didn't know. Also, the decision matrix and task planning sheets will be useful to many of my 7th graders. **GA, TP**
- (2006) I will use the engineering design process next year-I think it is a good approach to any project. I could probably recreate the wacky shoes lab for my classroom. **GA-DC, SW-IA-WS, TP**

(CW) Camp as a Whole

(ORG) Organization

- (2005) Maybe a little more "get to know you" time but I know how jam packed the schedule was anyways without adding more…Also, more active activities might help. **CW-ORG, GA-MHO**
- (2007) Level of organization and support. **CW-ORG**
- (2003) The level of organization. **CW-ORG**
- (2010) How well organized this program is, leadership of Chrys Sue and Audra, getting to know my colleagues better, the TAs, learning about engineering, forensic workshop, dance pod mania and wacky shoes. **CW-ORG CW-COL CW-TA IK SW-IA-FRN SW-IA-DP SW-IA-WS**
- (2010) A well planned, well organized and engaging camp. **CW-ORG**
- (2009) In every activity the problem was presented first and the campers were required to construct their own solution-I believe this order of events makes the activities memorable and boosts self-confidence. **GA-ORG**
- (2010) I wonder if you took the kids through the different types of engineering and lead one day where they could go back to the area they were most interested in. **GA, CW-ORG**

(COL) Colleagues

- (2010) How well organized this program is, leadership of Chrys, Sue and Audra, getting to know my colleagues better, the TAs, learning about engineering, forensic workshop, dance pod mania and wacky shoes. **CW-ORG CW-COL CW-TA IK SW-IA-FRN SW-IA-DP SW-IA-WS**
- (2002) Meeting the staff and campers-it was an incredible experience. **CW-COL CW-GIR**
- (2002) Watching how hard the campers worked and how well they worked together was amazing. **CW-COL**
- (2002) Working with the wonderful TAs and campers. **CW-TA, CW-COL**
- (2007) The feeling of community with the other teachers and the ability to work with the campers and TAs not direct them all the time. **CW-COL, CW-GIR, CW-TA**
- (2005) I enjoyed gaining a more broad understanding of engineering. I enjoyed working with a competent and friendly staff. I enjoyed meeting some great girls and having a lot of laughs while we worked towards a common goal. **IK, CW-COL, CW-GIR**
- (2009) It was extremely helpful to have a MST that had worked at the camp before-i can only imagine that it would be much more efficient in communication frustrations/ideas if I had never met the other middle school teachers. **CW-COL**
- (2008) As I stated in the mid-program evaluations, I have the advantage of being a science (as well as math) teacher. I have skills, knowledge, and experience teachers who teach only math may not have. I suggest picking science/math teachers and or preparing the math teachers more for the workshops. **SUG-PR**
- (2008) Supply boxes: Include at least 3 measuring tapes, 10 clipboards, 5 geometric shape templates, orienteering compass (as required by the project), geometric compass, 1 box of Kleenex and a bag of bandaids. Age appropriate design/scale drawing software. On attached sheet: at least one experienced MST, offer position to engineering teachers/media specialist? No gum in classrooms. **SUG-PR**

(GIR) Girls

- (2006) Getting to work with motivated young women was exciting and inspiring-this helped me to develop skills in inspiring them. **CW-GIR, TP**
- (2009) The motivated girls and great projects were the best. **CW-GIR, GA**
- (2002) Meeting the staff and campers-it was an incredible experience. **CW-COL, CW-GIR**
- (2002) The girls were incredible-the energy was huge-they were always busy during the day. **CW GIR**
- (2004) Working with the girls and the design team. **CW-GIR**
- (2011) I mostly liked working with an intelligent group of campers and TAs that were excited to be at the program. The girls seemed genuinely excited to help the community. **CW-GIR, CW-TA**
- (2007) The feeling of community with the other teachers and the ability to work with the campers and TAs not direct them all the time. **CW-COL, CW-GIR, CW-TA**
- (2010) Working with the girls on their design project and seeing their excitement during the workshops. **SW-IA-MDP, CW-GIR**
- (2005) My design project group was awesome. I am not sure I have ever worked with a group that worked together, supported one another, and completed assigned tasks as well as this one did. I really enjoyed working with my group and the time flew. **SW-IA-MDP, CW-GIR**
- (2005) I enjoyed working with my team and helping them gain confidence in their abilities to research, write, interview and present. I felt it was really powerful for the girls to start and finish a really tangible project in 2 weeks and enjoyed the challenge of trying to get them through the process. **SW-IA-MDP, CW-GIR**
- (2005) I enjoyed gaining a more broad understanding of engineering. I enjoyed working with a competent and friendly staff. I enjoyed meeting some great girls and having a lot of laughs while we worked towards a common goal. **IK, CW-COL, CW-GIR**

(EOG) Effect on Girls

- (2008) I really enjoyed working with three different age groups of hardworking, intelligent and forward- thinking women. Also, it was extremely satisfying to see my campers grow as independent and responsible learners. **CW-EOG**
- (2004) What an empowering experience for girls to have an impact on their community. **CW-EOG**
- (2004) The Bose trip and the fact that there are companies working with smart women, and treating them as equals. **SA, CW-EOG**

- (2006) The feeling that we were making a wonderful contribution to the community. **CW-EOG**
- (2003) The program is an amazing opportunity for young girls. **CW-EOG**
- (2006) I'm not sure how effective the field trip to Bose was for the girls-I think the best part of the trip for the girls was the exposure to women in important job roles-the trip could be made better if there were more hands on activities, rather than a tour of the facility. **CW-EOG, SW-MHO**
- (2004) My knowledge or attitude didn't change, but I am very happy to know that there are programs like Camp Reach to "grab" middle school girls attention and give them the opportunity to live, see, and feel math, science, engineering, and technology in action. **CW-EOG**

(TA) TAs

- (2005) I was unsure about TA "after hour" obligations, but it was never a serious issue. **CW-TA**
- (2010) How well organized this program is, leadership of Chrys, Sue and Audra, getting to know my colleagues better, the TAs, learning about engineering, forensic workshop, Dance Pad Mania and Wacky Shoes. **CW-ORG, CW-COL, CW-TA, IK, SW-IA-FRN, SW-IA-DP, SW-IA-WS**
- (2002) Working with the wonderful TAs and campers. **CW-TA, CW-COL**
- (2011) I mostly liked working with an intelligent group of campers and TAs that were excited to be at the program. The girls seemed genuinely excited to help the community. **CW-GIR, CW-TA**
- (2007) The feeling of community with the other teachers and the ability to work with the campers and TAs not direct them all the time. **CW-COL, CW-GIR, CW-TA**
- (2007) TA involvement in workshops-needs more direction. **CW-TA**
- (2006) The TAs should be aware that involvement with the campers as coaches provides them with the guidance they need. **CW-TA**
- (2006) Paying TAs and giving them a larger role in the design process and giving them some time off. **CW-TA**
- (2010) Have some way of holding the volunteer hours over TAs heads so they don't think the hours are automatic-they need to earn them. **CW-TA**
- (2010) The TAs. **CW-TA**
- (2005) Unbirthday party-Not sure how else to begin the week but this felt like a tough, slow start. Roles of TA's-More emphasis in training about how to facilitate discussion with 7th grade girls w/o giving them the answers-plus how they can be an asset during the project design process. **SW-SUG, CW-TA**
- (2010) Having the TAs ignore the girls to pursue their own interests. **CW-TA**
- (2008) Discuss other activities of the Cape besides castle building. Make sure the TA are clear on the building a circuit project. **SW-SUG, CW-TA**

(CS) Camper Selection

- (2009) Find a way to screen out girls who are attending because Mom or Dad are making them-perhaps
this could be accomplished with a phone interview or incorporated into the essay (why attend Camp Reach?). **CW-CS**
- (2009) The selection process for campers-the experience is so wonderful it is essential that students who want to participate are here-1 or 2 teacher recommendations or a "why and want to go to camp" paragraph might be good. **CW-CS**
- (2003) Some girls that I think should have been screened out. **CW-CS**

(NS) No Constructive Suggestions/Comments

- (2004) I don't have any suggestions for improvement. **NS**
- (2009) Jim's presentation was a bit overwhelming-I would have liked some information on his presentation ahead of time so I could better prepare questions so the students could've understood the topic better. **NS**
- (2009) It may have been a nice change of scenery if we had eaten lunch in another location. **NS**
- (2009) Having 3 MSTs here from Auburn will making bringing factors of camp back to school much easier. **NS**
- (2009) I have nothing negative to say about the camp, it was great. **NS**
- (2005) Honestly, there isn't anything I disliked about this experience. **NS**
- (2007) Trying to coordinate time with Marc. **NS**
- (2003) Too much food! **NS**

- (2002) Don't want to comment given the circumstances. **NS**
- (2004) Parking on a busy day! **NS**
- (2004) Not as much help is needed from us by campers as I thought. **NS**
- (2011) Have teachers do "initial observations of campus" within first few days so we can accurately compare. **NS**
- (2007) Keep the rest the same-you manage to weane the design process into such a wide variety of workshops and discussions. **NS**
- (2009) Some girls seemed to be have under dress-this was probably the only downside to camp. **NS**
- (2011) It didn't, Camp Reach 8 years ago started an 8 year journey through engineering and in fact forensics. **NS**

Appendix D: Teacher Interview Codes

(CR) Curriculum Restraints

-I feel like my thoughts on this are different than other teachers. I do have to cover far more than the kids are able to learn. I'm not able to go into the depth that I want to. This is a hard question for me to answer because I want to include engineering but I'm not always able to due to the amount of other material I need to cover. **CR**

-We are supposed to teach certain things, but if we didn't have guidelines then kids would have different knowledge's coming out of 7th grade. Yes it does, but maybe the state does need to have requirements. **CR**

-Yes, there's too much in the curriculum too much to cover **CR**

-Yes. We have 44 educational objectives that need to be covered in 32 weeks. It's difficult to do that alone, never mind incorporating engineering. They stress MCAS high scores so much that I feel like I cannot include engineering in my classroom properly. **CR**

-I barely get through my science curriculum. I can't imagine going through all the engineering requirements. **CR**

-Out of curriculum has more objectives to teach than out of curriculum. Teachers are rushing to complete their lessons now. **CR**

-Probably, yes. The standards are very precise, and the national standards are very precise as well. Even though engineering is very closely related to math, there are no engineering requirements in the math standards – national of MA. **CR**

-In science yes, but not so much in math. I do feel like there are time restraints. It's hard to go into depth on any one topic. It's hard to incorporate any more technology into my lessons. **CR**

-My district limits me more than the MA standards. **CR**

-I don't think it's the MA curriculum. The kids just don't get enough science in elementary school, so I have to teach them things that they were supposed to learn in elementary school, that they don't cover in there. I shouldn't have to be teaching the water cycle or how to measure with units in seventh grade. **CR**

-I don't especially for technology. Technology is a resource and tool we use to teach many concepts. As for engineering, there are standards so it hasn't hindered my teaching because it wasn't the focus of my courses . I do believe that MA accountability system has hindered our ability to teach science, like inquiry science and how to think scientifically. **CR**

-I don't because it's hard to do things with MCAS. There are things that I have to cover for MCAS and then get them ready for 7th grade. The tech-eng teacher does more engineering activity with the MA students. **CR**

-No, because I teach earth science. With MCAS we have certain things we have to be on task with. The balloon cars activity I put in because it's after MCAS and I have a little more free range to do the things I want then. I'm able to do the astronomy one earlier in the year because there is an astrology unit to be covered. When I go above and beyond, I run the risk of going into too much depth and not having the right MCAS scores. **CR IA-SA**

-No. The breadth of what we need to cover leaves us no time to cover other things that we may want to into our curriculum. I wish we could offer more depth and less breadth. That way we could do more activities or projects. **CR**

-I don't have anything like that software. I don't have access to any of this (technology that can be used in classrooms). It's hard to book computer rooms at all. My school makes it extremely difficult for teachers to use computers in activities. I don't even have access to WiFi as a teacher at her school. Also, our computers are very old and don't run, they crawl. **CR/SCHOOL RESTRAINTS**

-Before CR, nothing. There wasn't much available. Since CR, NST there was a conference that took place and almost all classes were STEM classes. It's becoming more prevalent that STEM is working its way in. Life science: STEM is minimal. I'm trying to satisfy what MA wants and little of what I want. It's a big time commitment and to get training. And if state doesn't require it then it's hard to incorporate due to the current states curriculum demands. **PPDP-STEM CR**

-Definitely! It's totally changing the way I'm teaching. I was really happy with how I changed my choice starting the school year: started differently. I'm including lessons that help make inquiry-building skills. This class made me want to teach my colleagues! But we worry too much about MCAS. **IA-AP CR**

-If it's going to be used as a Professional Development Program then teachers might want to be teachers who teachers are teaching engineering, math and life science. Doesn't have to be but as a PDP for STEM subjects then it may be more helpful to teaching who actually teach it and can incorporate it would benefit from it. The concepts are a little difficult. But when Kids see the actual model and can see how the concepts apply. The activities aren't ones that teachers would implement in school. I have 18 life science frameworks and 20 core curricula that I have to abide by. Would be fun to take a day to build but there's not much time. **SUG-OTH SUG-TEA SUG-PDP-LES CR**

(IK) Increased Knowledge of Engineering

-Most of my education regarding engineering was self-taught, so I wanted to have experience from engineers. **IK**

-It's a positive experience for the girls and myself. They covered a large array of topics involving engineering where you learn a lot. It was great to experience things (the hands on stuff) instead of listening to a lecture on engineering. **IK**

-The projects. Being able to assist the girls in groups. Also, going through the design process and coming with an end result that was going to help somebody someday. Also, learning how to think as a scientist. **SW-MDP IK**

-I may have taught a unit on engineering once, attended CR, and then revamped the lesson with some materials that I had learned from CR. I (did) use some of the materials from the camp. **IK**

-I can't really think of anything specific to offer. It was jam packed. It was one good thing after another; it was invigorating. Working with kids was fun. I felt engaged by a lot of the materials, both as a teacher and as an adult. It gave me a fuller picture and a glimpse of engineering. Denise was awesome. **IK CW-ORG**

(CAR) Engineering as a Career

-Yes, I felt that my education of the engineering design process and the careers in engineering expanded. I felt like I knew more about the engineering design process. It gave me a bigger background to teach with. CR also gave me a different philosophy of how to approach things, unlike my school's (professional development programs). **IK-DC IK-CAR TP**

-I can't say it changed the material I teach. It gave me a new appreciation of what engineers do. I feel like I have a better grasp of what engineering is about. I don't do a lot of career promotion in 6th, but I do encourage my female students to go towards math and science. **TP-FOG IK-CAR**

-I had fairly limited knowledge before Camp Reach. The most familiar was engineering discipline was civil, but I also knew a little about chemical engineering. The workshops made engineering seem like a lot of fun and hands on. I also learned are many kinds of engineering. There are many more types of engineering out there than people think. **IK-CAR**

-I had limited knowledge. When I was in high school, a lot of students wanted to pursue a career in engineering because their parents were engineers. My parents weren't so I didn't know about engineering. If you build something then you're an engineer. You can get a great job and pays a lot of money. It's about problem solving. And later I learned why students want to be an engineer. CR let me learn that there's more. In regards to problem solving, I liked going to the Bose factory. We want to make something that can see inside of patients. Talked to the engineers and helped me understand engineering more. Helping people live better lives. **MIS-CAR IK-CAR**

-I couldn't discern between the different engineering fields (CEE, ME, BME, etc). Also I learned a lot about the engineering design cycle while at camp. **IK-CAR IK-DC**

-Prior to CR I had been using a curriculum where students learned about different engineering careers. CR added more detail to my knowledge base. **IK-CAR**

-I knew that engineering was a design process similar to the science process. I was aware of the different careers in engineering, but now I know the different careers and what they do better. **IK-CAR**

-Before the first year, I knew very little. I had friends that were engineers, but never really knew about the process. After I could talk to my kids about the different opportunities in engineering. I learned a lot about different careers in engineering. **IK-CAR IK-DC**
-Before CR, it was minimal. I knew the obvious things such as the types of engineers. When I came to CR, I realized that there are more branches/directions of engineering than thought. All engineers are not the same. It was neat to meet all the different staff. I personally learned a lot from them and it made me a better teacher. **IK-CAR TP**
-In college, I had a major in environmental engineering. So, I knew a bit about it. And background. CR opened my eyes to what opportunities some students (suburban vs. urban) were available for each. **IK-CAR**
-Imaginary numbers and where they can be applied to in the real world. Denise sat down with me and showed me all the stuff about imaginary numbers and has showed many people that. I mentioned some facts that were said during the fire demonstration also. The binder was helpful. Having broader perspective of math and science gives me more chance to incorporate it in classrooms. I learned a lot about group work and how engineers work in groups, which was more effective. **IA-GA IK-CAR TP**

(DC) Engineering Design Cycle

-Yes, I felt that my education of the engineering design process and the careers in engineering expanded. I felt like I knew more about the engineering design process. It gave me a bigger background to teach with. CR also gave me a different philosophy of how to approach things, unlike my school's (professional development programs). **IK-DC IK-CAR TP**
-I had a fairly good idea of what engineering is about. My husband is an electrical engineer and my daughter is a materials engineering. I never taught anything with engineering/engineering design process before CR though. I only had experience in earth science, biology, and geology before attending CR. But I learned a lot that summer about the engineering design process. Now I teach an engineering unit if I have time: balloon cars with velocity and acceleration problems for the students. **IK-DC IA-GA**
-I couldn't discern between the different engineering fields (CEE, ME, BME, etc). Also I learned a lot about the engineering design cycle while at camp. **IK-CAR IK-DC**
-Before the first year, I knew very little. I had friends that were engineers, but never really knew about the process. After I could talk to my kids about the different opportunities in engineering. I learned a lot about different careers in engineering. **IK-CAR IK-DC**

(RFA) Reason for Attending

-I got my degree in bio and Spanish and I've always liked working with kids. I wanted to work with all girls (not just boys) for once. From a PDP standpoint, I felt like I needed more PD in engineering specifically, not just bio. And I felt like it was a quality program. **IK-RFA**
-I had heard about it over the years and met a few students that had gone. One of the teachers I teach with has attended CR so I was interested. I wanted to learn more about the engineering process and incorporate more engineering into my class. CR seemed to offer this. **IK-RFA**
-I came from a biology research position. I didn't know much about engineering, so I thought Camp Reach would be a great way to learn more about engineering. **IK-RFA**
-I was interested in learning more about the engineering process. I was trained in math only so it was something different for me education-wise. Also, I want to see how math applied. CR involves working with middle school students and I'm a Middle School Teacher. **IK-RFA**

(SW) Specific Workshops

-It was wonderful. I learned a lot about the group process of engineering. All the parts add up to make a whole (the labs, handicap project, technology). Went to Bose radio for a tour. They weren't learning science specifics, but it was very informative. I was able to bring a lot of it to the middle school I was teaching. It gave a well-rounded picture of science and math **SW TP**
-I focused more on the life-science stuff. I liked the microbiology unit. **SW**
-(Has trouble remembering the workshops). Forensics, handicap/wheelchair one, the kids loved the biology one. I don't know if one stood out beyond the others. The kids loved them all. **SW-FRN SW**
-The round robin table one that involved stuff with ph levels and pollution sites and their levels. I liked it because of my chemistry background. **SW**

-The ECE lab when they put radio together. The whole engineering process was really good for the girls to go through. They had to brainstorm and put together their ideas and then have a finished product. **SW SW-MDP**

-I always wanted to come back. I always read about their competing program. There wasn't a shortage of girls in program. There's a problem about whether the girls become engineers. Best part was going to Bose. That was the amazing part. A lady there was the first engineer at Bose. That floored me because I didn't expect women to be women would've been around before that. It's important that there are efforts to involve girls. CR can reach out to more schools. Multiple teachers can work together on the projects in the district. **SUG-OTH SW SUG-OUT**

(MDP) Major Design Project

-The level of maturity of what we did, the expectation so the girls: socially, academically, and the daily requirements. The big project we really interacted with adults. It was amazing to see the girls interact with the adults. It was also great to get to know the other teacher I work with. The second year I did the camp I got to know my colleagues a lot better. **SW-MDP CW-COL CW-GIR**

-The project – My project was about (although the project I had not one of the better projects that year) looking for technology for a nursing home to help them up to speed using computers. We were looking at special types of keyboards, mice, and etcetera. It was to help the nursing home residents communicate w/friends and family or play games on the computer. A lot of measurements, cost of the materials, and thought or organization was involved. **SW-MDP**

-I had a great experience. I really remember working with the community in Worcester. I also enjoyed working with the TAs. All around, the camp was great. The workshops were well planned. **CW-TA SW-MDP CW-ORG**

-I really remember being at the site and feeling a sense of pride for/in the girls for planning a project that helped the community. It was nice having a goal and working towards it. In the short amount of time we got a lot of things done. **SW-MDP**

-The projects. Being able to assist the girls in groups. Also, going through the design process and coming with an end result that was going to help somebody someday. Also, learning how to think as a scientist. **SW-MDP IK**

-Personally I was impressed how much good the past projects did for the Worcester community. For the project that I had worked on, a half-way house, it was nice and made me proud to make this place better and more beautiful than it was. For professionally I had the most connection with the engineering design process b/c I teach the scientific method in my classes. I didn't get anything new out of it that I apply to my classes now that I teach. **SA-MDP**

-I remember one where the girls had to design shoes – that was very effective. The group projects were also very effective. The forensics lab was effective as well. I don't remember the workshops very well though. **SW-WS SW-MDP SW-FRN**

-The ECE lab when they put radio together. The whole engineering process was really good for the girls to go through. They had to brainstorm and put together their ideas and then have a finished product. **SW SW-MDP**

(FRN) Forensics

-The forensics workshop had the most diverse engineering activities for them – they had a lot of different processes they had to go through. **SW-FRN**

-The one I remember best is the forensics lab. **SW-FRN**

-I remember one where the girls had to design shoes – that was very effective. The group projects were also very effective. The forensics lab was effective as well. I don't remember the workshops very well though. **SW-WS SW-MDP SW-FRN**

-They were all fun. There were a lot of cool things for the kids to do like the forensic science activity. I really remember the handicap awareness and forensic activities. They liked the robotics lab too. Each workshop (and professor in the workshop) had its own way of making an impression on the campers. **SW-FRN**

-(Has trouble remembering the workshops). Forensics, handicap/wheelchair one, the kids loved the biology one. I don't know if one stood out beyond the others. The kids loved them all. **SW-FRN SW**

(WS) Wacky Shoes

-I remember one where the girls had to design shoes – that was very effective. The group projects were also very effective. The forensics lab was effective as well. I don't remember the workshops very well though. **SW-WS SW-MDP SW-FRN**

-I remember that they were well done. There was a project related to designing a shoe. I thought it was a creative way to have the girls learn about the project. **SW-WS**

-The wacky shoes workshop was great. Also, the rocket activity was really interesting to watch and see the different outcomes of the project. The dance pad activity was great too. **SW-WS SW-ROC SW-DP**

-They were all fantastic. One of the ones was where the girls had to design a shoe. I thought it was fluffy at first (materialistic item). But it was great to see the girls come up with a creative solution with something they may like. The dance pad drew them in too – they were interested in these activities. **SW-WS SW-DP**

-The wacky shoes workshop: that was great because it was so hands on. The girls could put a lot into it and get a lot out of it. Other workshops were more lecturing than hands on for the girls. The wacky shoes was much more fun, although the other workshops were not less valuable. Seeing things burn and freeze was definitely memorable for the girls as well. **SW-WS**

(ROC) Rockets

-Dance pad was effective because it utilized many building aspects. Using diff materials and lots of different designs. Making something that worked. Rocket one. I am passionate about rockets. Each teacher had a different station. Kids would go to each station for 20 minutes. Campers got to do different types of engineering problems. Kids loved it. **SW-DP SW-ROC**

-The wacky shoes workshop was great. Also, the rocket activity was really interesting to watch and see the different outcomes of the project. The dance pad activity was great too. **SW-WS SW-ROC SW-DP**

(DP) Dance Pad

-Dance pad was effective because it utilized many building aspects. Using diff materials and lots of different designs. Making something that worked. Rocket one. I am passionate about rockets. Each teacher had a different station. Kids would go to each station for 20 minutes. Campers got to do different types of engineering problems. Kids loved it. **SW-DP SW-ROC**

-The wacky shoes workshop was great. Also, the rocket activity was really interesting to watch and see the different outcomes of the project. The dance pad activity was great too. **SW-WS SW-ROC SW-DP**

-They were all fantastic. One of the ones was where the girls had to design a shoe. I thought it was fluffy at first (materialistic item). But it was great to see the girls come up with a creative solution with something they may like. The dance pad drew them in too – they were interested in these activities. **SW-WS SW-DP**

(CW) Camp as a Whole

(ORG) Organization/Planning

-There was a lot of teacher time and time to talk with Chrys and Sue. Teachers crave teacher time because we are with kids all the time. I enjoyed having my group of ten kids that were really motivated. Going to field trips and putting together presentations. It was good watching girls work on individual projects and Problem Solving. It was all great. **CW-ORG**

-I was extremely beyond impressed with the organization of CR. The attention to details, time and schedule was amazing. The amount of work that went into it to keep the girls engaged was incredible. I was blown away. I had a good group of girls and TAs. I wished we had meetings between the teachers and the TAs between activities to be on the same page. **CW-ORG CW-GIR**

-I feel like I've forgotten a lot. I do remember that I had felt that it was very well organized and there was a lot of clarity in the roles of the staff and structure of the program. The campers were given a lot of responsibility, and my role was more of a coach to the campers. **CW-ORG**

-I had a great experience. I really remember working with the community in Worcester. I also enjoyed working with the TAs. All around, the camp was great. The workshops were well planned. **CW-TA SW-MDP CW-ORG**

-For me I was amazed that with the amount of time and support we had, we were able to come up with some creative solutions. It was amazing to see what the girls could come up with on their own. **CW-ORG CW-GIR**

-I was impressed with how well planned it was, the efficiency and organization of the day to day process of CR. Chrys was the person I dealt with the most. She knew the balance of letting the teachers do their thing but also getting involved. She would throw out pertinent information that everyone needed. **CW-ORG**
-I think Camp Reach rocks! The way they have it set up is so smooth. They have honed this perfectly. **CW-ORG**
-I can't really think of anything specific to offer. It was jam packed. It was one good thing after another; it was invigorating. Working with kids was fun. I felt engaged by a lot of the materials, both as a teacher and as an adult. It gave me a fuller picture and a glimpse of engineering. Denise was awesome. **IK CW-ORG**

(SUG) Suggestions for Improvement

-Don't limit it to 6th or 7th grade girls. Or maybe have another program for 8th grade girls. The number of girls was a hard dynamic, but it was great to have that many girls. I don't know what there is to have a specific change. Better promotion: Get representative from WPI to the schools. Calling on the former MSTs to have them talk to the other schools. Teachers would like to talk to other MSTs that have been through the program. **CW-SUG SUG-OTH**
-Our tech-eng teachers can incorporate the things CR teaches into their program. Maybe CR should hire more tech-eng teachers instead of math/science teachers. Make time during the day for the MST to sit and get to know the TAs so they can work as a time. There were some disagreements between the TAs and the MSTs. (Need to facilitate the TAs better). **SUG-TEA CW-SUG**
-What CR does is fabulous. I think the biggest problem in general (for any program) is finding authentic programs for the girls to work on. There wasn't a huge emphasis on the PDP part in the orientation. But the end product was what was going on with the girls. The way the professors deliver the content so that there is a consistent way for the teachers to see how they can implement. For example: making it specific what the end project presentation should cover. That way the teachers can see what they could expect with the project if they did. There should be a break for the TAs…but I don't see how that can happen. The girls weren't keeping a notebook. It was great because the whole thing was very relaxed and the girls excelled without a grade. **CW-SUG SUG-OTH**

(PDP) As a Professional Development Program

-It was the first opportunity where I felt that you can integrate math and science in a fun, practical, hands on way with just girls. I also felt that the girls attending would be unique girls that would want to learn about things involving STEM. It was good to get the girls excited. It was one of the opportunities for me to have fun learning more about stem than regular teaching programs. **CW-PDP**
-I really believe that there should be more women in engineering. I wanted to become involved in something that evolved social views of engineering. I wanted to get involved, meet other teachers, and work with kids. Other PD programs you just sit with teachers and not be involved with the kids. I read some articles about Camp Reach. I get to work with kids and teachers outside my district. **MIS-ENG CW-PDP**
-Both my years there were very different experiences. The first year became the stepping-stone for me to take science professional development programs. I've done about 4 other engineering positions through WPI because of Camp Reach. Camp Reach showed me the relevance of teaching engineering in the classroom. **CW-PDP**

(COL) Colleagues

-The level of maturity of what we did, the expectation so the girls: socially, academically, and the daily requirements. The big project we really interacted with adults. It was amazing to see the girls interact with the adults. It was also great to get to know the other teacher I work with. The second year I did the camp I got to know my colleagues a lot better. **SW-MDP CW-COL CW-GIR**

(GIR) Girls

-The level of maturity of what we did, the expectation so the girls: socially, academically, and the daily requirements. The big project we really interacted with adults. It was amazing to see the girls interact with the adults. It was also great to get to know the other teacher I work with. The second year I did the camp I got to know my colleagues a lot better. **SW-MDP CW-COL CW-GIR**
-I was extremely beyond impressed with the organization of CR. The attention to details, time and schedule was amazing. The amount of work that went into it to keep the girls engaged was

incredible. I was blown away. I had a good group of girls and TAs. I wished we had meetings between the teachers and the TAs between activities to be on the same page. **CW-ORG CW-GIR**
-For me I was amazed that with the amount of time and support we had, we were able to come up with some creative solutions. It was amazing to see what the girls could come up with on their own. **CW-ORG CW-GIR**
-The girls! I enjoyed working with the students. The camp showed me how creative the girls were. I was amazed how much kids can come up with. The campers thought of a lot of new ideas. It was great to see. **CW-GIR**
-The kids love the activities. Initially Denise had the kids come back from CR to do activities with the camp during the year, and they loved it. Once the kids did a design project, their view of the world shifted – they saw that there were problems in the world and they wanted to fix them. Also, the girls thought they had gained more confidence. **CW-GIR**

(TA) TAs

-I had a great experience. I really remember working with the community in Worcester. I also enjoyed working with the TAs. All around, the camp was great. The workshops were well planned. **CW-TA SW-MDP CW-ORG**

(TP) Teaching Pedagogy

-It was wonderful. I learned a lot about the group process of engineering. All the parts add up to make a whole (the labs, handicap project, technology). Went to Bose radio for a tour. They weren't learning science specifics, but it was very informative. I was able to bring a lot of it to the middle school I was teaching. It gave a well-rounded picture of science and math **SW TP**
-At the time I was teaching middle school and did so for one more year. It gave me some ideas of how to get kids to think through applications using math. I think if I had stayed in middle school I would have been able to continue to use more what I had learned. **TP**
-Yes. I tried to facilitate more in my classrooms instead of just teach/lecture. I was moved by the kids spirits and stories in my group. **TP**
-Yes, I felt that my education of the engineering design process and the careers in engineering expanded. I felt like I knew more about the engineering design process. It gave me a bigger background to teach with. CR also gave me a different philosophy of how to approach things, unlike my school's (professional development programs). **IK-DC IK-CAR TP**
-Originally, I felt much more comfortable bringing engineering into my classroom. Before I was scared to bring it into my classroom. I gained a little more self-efficacy. It was a great beginning. **TP**
-Before CR, it was minimal. I knew the obvious things such as the types of engineers. When I came to CR, I realized that there are more branches/directions of engineering than thought. All engineers are not the same. It was neat to meet all the different staff. I personally learned a lot from them and it made me a better teacher. **IK-CAR TP**
-Imaginary numbers and where they can be applied to in the real world. Denise sat down with me and showed me all the stuff about imaginary numbers and has showed many people that. I mentioned some facts that were said during the fire demonstration also. The binder was helpful. Having broader perspective of math and science gives me more chance to incorporate it in classrooms. I learned a lot about group work and how engineers work in groups, which was more effective. **IA-GA IK-CAR TP**
-They like the hands on aspect. It's different than what they do in a math class. Some of these kids aren't used to doing that type of stuff. We have an engineering and art teacher that work with the hands on stuff. You get them to think in a different way. **IA TP**

(FOG) Focus on girls

-I've always tried to come up with ways where I can encourage my kids to explore different areas. (I have a daughter that's an engineer). I like the way CR encourages women to participate in fields that are not "female oriented." I share my experiences with my students: "Just because you're a girl doesn't mean you can't do these things!" At CR you get a chance to see how capable students are when they don't have to follow the restraints of a classroom. **MIS-ENG TP-FOG**
-I can't say it changed the material I teach. It gave me a new appreciation of what engineers do. I feel like I have a better grasp of what engineering is about. I don't do a lot of career promotion in 6th, but I do encourage my female students to go towards math and science. **TP-FOG IK-CAR**

-Yes. I felt myself focusing on the girls more. I was trying to reach out to them more. During high school they start to segregate more, not as many girls in math and sciences. In middle school the number of strong males and females are equal. During high school this changes. I was positive about planting seeds with the girls about pursuing careers in math and science. Tried to get some of the girls in his class to attend Camp Reach. Girls are more educated where I am teaching now. I had taken some of the projects and adapted them into my classroom the year after attending Camp Reach. I haven't sustained it too long. Beach, sandcastle project/ workshop were incorporated. I think they tried to make it like a project like engineering. I tried taking the projects and applying them into classrooms. It didn't go great all the time, I was kind of faking it, I'm not an engineer, but it was helpful. **TP-FOG MIS-ENG IA-SA IA-GA**

-It did. I am somewhat partial to getting girls involved in STEM. It's a population that needs to know that they can succeed in fields that require that background. When I was in school, it wasn't pushed that girls were in that field and those were my strengths. I want to make it easier for girls to know that it their good at math in science, they shouldn't get discouraged because of the current outlook. Go with your strengths. **TP-FOG MIS-ENG**

-I don't know if I address the misperceptions directly. I address the other issues more often – the gender issue. I try to give them more of a love of engineering **TP-ENC TP-FOG**

(ENC) Encourage Engineering/Clarifying Misperceptions

-Yes, I can clarify them to my students. **TP-ENC**

-Yes **TP-ENC**

-Engineering is definitely related to the field of science, so I try to do what I can to get them interested. I'm able to show students that there are other careers out there than what their parents do for a living. **TP-ENC**

-I push science strongly in my classroom and point out when girls participate more. I don't it regularly. When the opportunity comes up I do it. Books mainly have male scientists. Highlight female scientists in class. **TP-ENC**

-Yes I am. Sometimes kids don't see themselves clearly and don't see what they are good at. The parents also don't believe that they themselves are good at math and can't help the kids. I'm also able to tell the parents this is not true. The kids don't see that everything they use was touched by an engineer. For fun I had a kid design a "pencil security system" in my homeroom since pencils kept going missing in my class. **TP-ENC IA-GA**

-I don't know if I address the misperceptions directly. I address the other issues more often – the gender issue. I try to give them more of a love of engineering **TP-ENC TP-FOG**

-Yes because I used to have these misperceptions too. I can help clarify the same thoughts I had with my students. **TP-ENC**

-These misperceptions/discussions don't come up very often. One lady came to my school to talk about CR. I gave application to girls I thought should go. Conversations did come up for broadening horizons and looking at science/engineering differently after I gave the girls the applications. **IA-GA TP-ENC**

-I can address them when students ask me in class **TP-ENC**

-I do as a focus instructional coach; I get to go to different classrooms and different trade areas. I get to incorporate my view and introduce critical thinking into stem. I'm also science fair coordinator. I have kids do projects related to technology. **TP-ENC**

-When I show them engineering application to real problems, addressing different careers **TP-ENC**

-It tends to be a very informal conversation. Like in conversation "when am I ever going to use this??" when kids ask. I take the time there to go into different professions. I explain that geometric proofs for example get you thinking, thinking like some professions use. **TP-ENC**

-I can tell kids if they are strong in the STEM areas **TP-ENC**

-I give the students positive views of engineering and engineers. **TP-ENC**

- I give the application to kids I think should go **TP-ENC**

(IA) Implemented Activities

-Yes **IA**

-Yes **IA**

-Yes **IA**

-They like the hands on aspect. It's different than what they do in a math class. Some of these kids aren't used to doing that type of stuff. We have an engineering and art teacher that work with the hands on stuff. You get them to think in a different way. **IA TP**
-I try to give them example of my experiences in class. **IA**

(GA) General Activities

-These misperceptions/discussions don't come up very often. One lady came to my school to talk about CR. I gave application to girls I thought should go. Conversations did come up for broadening horizons and looking at science/engineering differently after I gave the girls the applications. **IA-GA TP-ENC**
-Yes! That fall when we went back to school we were losing half of our grade level, where I could create a problem solving class where most of the class was based on CR. Before the new standards came out I was able to do a double block of math and engineering. **IA-GAA**
-Yes. I felt myself focusing on the girls more. I was trying to reach out to them more. During high school they start to segregate more, not as many girls in math and sciences. In middle school the number of strong males and females are equal. During high school this changes. I was positive about planting seeds with the girls about pursuing careers in math and science. Tried to get some of the girls in his class to attend Camp Reach. Girls are more educated where I am teaching now. I had taken some of the projects and adapted them into my classroom the year after attending Camp Reach. I haven't sustained it too long. Beach, sandcastle project/ workshop were incorporated. I think they tried to make it like a project like engineering. I tried taking the projects and applying them into classrooms. It didn't go great all the time, I was kind of faking it, I'm not an engineer, but it was helpful. **TP-FOG MIS-ENG IA-SA IA-GA**
-I had a fairly good idea of what engineering is about. My husband is an electrical engineer and my daughter is a materials engineering. I never taught anything with engineering/engineering design process before CR though. I only had experience in earth science, biology, and geology before attending CR. But I learned a lot that summer about the engineering design process. Now I teach an engineering unit if I have time: balloon cars with velocity and acceleration problems for the students. **IK-DC IA-GA**
-Definitely. I can show them real world problems of how math is applied to engineering. **IA-GA**
-Yes, I brought new activities of engineering into my classroom **IA-GA**
-Just a little. Little building and problem Solving. Not making things were kids are testing. Life science related so there not really building something. Try this out and change it and then retest. Because of nature of subject engineering is not applied as much. **IA-GAA**
-Absolutely. We've been working a lot of engineering projects. I gave my students a chance to redesign our classroom. They failed the first time, so I had them do it again to find a real solution. **IA-GA**
-In a 9 week unit we incorporated engineering into creating machines/collaborative group work. We used the engineering process to create the Rube Goldberg machine. The students learned about energy and magnetism while their goal was to raise a flag. It was more about using the engineering design process. Other than that project we haven't done as well since incorporating engineering into the curriculum. We did have engineers as speakers at the school. **IA-GA IA-DC**
-I did! After CR Karen and I incorporated one of the activities and now use it on an annual basis now. We're working on a problem solving cycle as well, and use the guidance CR gave us of the cycle to do this activity. **IA-GA IA-DC**
-I definitely applied it. Right now I'm getting ready to do an activity about minerals. Part of the project is looking at how things are to be made. I haven't done a design project with my students, but I have encouraged them to do similar projects. In the past a similar project was an earthquake project, which was designing a building for the earthquake proofing. **IA-GA**
-Not exactly. The engineering process is a good thing to keep in mind. I would mention it, not by name, and go through the steps to help students with certain projects. **IA-GA**
-We did a balloon-car velocity activity with the kids **IA-GA**
-My kids redesigned our classroom as a project **IA-GA**
-The Rube Goldberg machine project **IA-GA**
-We did a design project based on what we did at CR. I let the kids brainstorm real-world problems that they would pick from. **IA-GA**

-Mineral and earthquake activities **IA-GA**
-We use engineering when we do the scientific method. We also introduce flow sheets. When they do bridges we cross them over with forces. I've done projects with broken arms; similar to something we did at CR. We talk about fire engineers and activities we did at camp involving that. **IA-GA IA-SA**
-Imaginary numbers and where they can be applied to in the real world. Denise sat down with me and showed me all the stuff about imaginary numbers and has showed many people that. I mentioned some facts that were said during the fire demonstration also. The binder was helpful. Having broader perspective of math and science gives me more chance to incorporate it in classrooms. I learned a lot about group work and how engineers work in groups, which was more effective. **IA-GA IK-CAR TP**
-I plan to use the ear activity in my class this spring. **IA-GA**
-The kids are very involved in the engineering activity I do. It's a challenge for them that they like. Especially since its hands on, they enjoy working through the problem. **IA-GA**
-They loved the activities! **IA-GA**
-They love it! The kids love any kind of lab. It's great that they love the lab, but they have to understand why we're doing it. They love anything different. They're usually really well behaved because they want to do the labs. **IA-GA**
-Yes I am. Sometimes kids don't see themselves clearly and don't see what they are good at. The parents also don't believe that they themselves are good at math and can't help the kids. I'm also able to tell the parents this is not true. The kids don't see that everything they use was touched by and engineer. For fun I had a kid design a "pencil security system" in my homeroom since pencils kept going missing in my class. **TP-ENC IA-GA**
-Yes. Some from CR **IA-GA**

(SA) Specific Activities

-Yes definitely! The ice-cream social project we now use as an introduction in our classrooms. (Make a sundae and show it to a friend to get to know the level detail small things like this would need). It showed a definite different way to approach learning than book and paper. **IA-SA**
-Yes. I felt myself focusing on the girls more. I was trying to reach out to them more. During high school they start to segregate more, not as many girls in math and sciences. In middle school the number of strong males and females are equal. During high school this changes. I was positive about planting seeds with the girls about pursuing careers in math and science. Tried to get some of the girls in his class to attend Camp Reach. Girls are more educated where I am teaching now. I had taken some of the projects and adapted them into my classroom the year after attending Camp Reach. I haven't sustained it too long. Beach, sandcastle project/ workshop were incorporated. I think they tried to make it like a project like engineering. I tried taking the projects and applying them into classrooms. It didn't go great all the time, I was kind of faking it, I'm not an engineer, but it was helpful. **TP-FOG MIS-ENG IA-SA IA-GA**
-We use engineering when we do the scientific method. We also introduce flow sheets. When they do bridges we cross them over with forces. I've done projects with broken arms; similar to something we did at CR. We talk about fire engineers and activities we did at camp involving that. **IA-GA IA-SA**
-The "who did it" forensics was great for the girls to do. There were all these different engineering processes for the girls to do and see. And at the end there was a winner, which was great. **IA-SA**
-No, because I teach earth science. With MCAS we have certain things we have to be on task with. The balloon cars activity I put in because it's after MCAS and I have a little more free range to do the things I want then. I'm able to do the astronomy one earlier in the year because there is astrology to be covered. When I go above and beyond, I run the risk of going into too much depth and not having the right MCAS scores. **CR IA-SA**
-The ice-cream sundae activity I've been able to incorporate into my class. We apply the idea that detail oriented instructions are important as an intro to approaching problems. **IA-SA**
-That engineering one, involving the ph we're using in my classroom this year. We're also doing the rocket one from Camp Reach. **IA-SA**
-Yes, one similar to the shoes. We talk about what type of material would be marketable. What do you have consider to make the shoes (what do you have to buy) **IA-SA**

-The kids love the physical and hands on activities we do (ice-cream one). **IA-SA**
-There was no gender difference in that activity. Everyone enjoys the sundae activity – everyone has fun but there is still a strong lesson learned from it. **IA-SA**
-One of my colleagues at camp was able to bring the forensics to her classroom. **IA-SA**
-They just enjoy the activity (ice-cream social). **IA-SA**

(DC) Engineering Design Cycle

-In a 9 week unit we incorporated engineering into creating machines/collaborative group work. We used the engineering process to create the Rube Goldberg machine. The students learned about energy and magnetism while their goal was to raise a flag. It was more about using the engineering design process. Other than that project we haven't done as well since incorporating engineering into the curriculum. We did have engineers as speakers at the school. **IA-GA IA-DC**
-I did! After CR Karen and I incorporated one of the activities and now use it on an annual basis now. We're working on a problem solving cycle as well, and use the guidance CR gave us of the cycle to do this activity. **IA-GA IA-DC**

(AP) From another PDP

-I worked at WPI (Teachers with Engineering. I do the astronomy activity for my students. It has to do ith bone density of astronauts and the students do a lab about how dense astronauts bones are in space. **IA-AP**
-MA Science and Engineering Fair: Inquiry in the classroom. Week long, absolutely amazed b/c they did so many different things. Felt like a lot of outcomes could have come from the program. Had to bring in materials that I had implemented in my classrooms. It wasn't cheap. Got an award so she could go. **IA-AP**
-ASSESsments at WPI allows me to have students do homework online, which I have definitely used **IA-AP**
-For a few years I use to do a bridge building exercise with straws and tape that I picked up from a PDP. **IA-AP**
-I have used a few things from Teacher with Engineering. **IA-AP**
-Sure. At this point I can't recall much because most of it isn't actual activities. It's about methods. For example, one PD program in school is about questioning. Another one is about folding paper, using it for studying purposes and making concepts easier to understand **IA-AP**
-Implemented ideas and concepts **IA-AP**
-Yes (wind turbines and robotics activities) **IA-AP**
-Definitely! It's totally changing the way I'm teaching. I was really happy with how I changed my choice starting the school year: started differently. I'm including lessons that help make inquiry-building skills. **IA-AP**
-This class made me want to teach my colleagues! But we worry too much about MCAS. **IA-AP CR**
-Absolutely, the TSIP, density bottles. All science teachers are using density bottles. There are 8 labs that go along with that. I presented on how to involve kids with engineering and technology. Inquiry unit on ice and how temp changes and others on Cosmetology. Inquiry lesson with some disease and there was an interactive web base. **IA-AP**

(MIS) Misperceptions of Engineering

-Yes **MIS**
-Yes, More often people don't have concepts of engineering. **MIS**
-No. The stereotypes that I have been to exposed to in my life come from students, parents, or other teachers. **MIS**

(ENG) Engineering not for girls

-The girls. They seem to be shrinking away from engineering, thinking it's a guy's job. It's important for females to continue growing in the engineering disciple. **MIS-ENG**
-I really believe that there should be more women in engineering. I wanted to become involved in something that evolved social views of engineering. I wanted to get involved, meet other teachers, and work with kids. Other PD programs you just sit with teachers and not be involved with the kids. I read some articles about Camp Reach. I get to work with kids and teachers outside my district. **MIS-ENG CW-PDP**

-I read something and a week later I was a part of CR. My degree is not in education, but in applied math and physics. In 1980 there were a lot (300+) of people taking the engineering tests, and only two of us were female. I wanted to be a part of CR because of the female ratio. **MIS-ENG**
-I've always tried to come up with ways where I can encourage my kids to explore different areas. (I have a daughter that's an engineer). I like the way CR encourages women to participate in fields that are not "female oriented." I share my experiences with my students: "Just because you're a girl doesn't mean you can't do these things!" At CR you get a chance to see how capable students are when they don't have to follow the restraints of a classroom. **MIS-ENG TP-FOG**
-Yes. I felt myself focusing on the girls more. I was trying to reach out to them more. During high school they start to segregate more, not as many girls in math and sciences. In middle school the number of strong males and females are equal. During high school this changes. I was positive about planting seeds with the girls about pursuing careers in math and science. Tried to get some of the girls in his class to attend Camp Reach. Girls are more educated where I am teaching now. I had taken some of the projects and adapted them into my classroom the year after attending Camp Reach. I haven't sustained it too long. Beach, sandcastle project/ workshop were incorporated. I think they tried to make it like a project like engineering. I tried taking the projects and applying them into classrooms. It didn't go great all the time, I was kind of faking it, I'm not an engineer, but it was helpful. **TP-FOG MIS-ENG IA-SA IA-GA**
-It did. I am somewhat partial to getting girls involved in STEM. It's a population that needs to know that they can succeed in fields that require that background. When I was in school, it wasn't pushed that girls were in that field and those were my strengths. I want to make it easier for girls to know that it their good at math in science, they shouldn't get discouraged because of the current outlook. Go with your strengths. **TP-FOG MIS-ENG**
-Before CR I had a very vague notion of engineering (narrow notion). After CR I realized that this was something that I would've really liked to go into as a student. I thought that it was for very smart people and just for boys when I was in high school. **MIS-CAR MIS-ENG**
-Absolutely. I think there is the traditional scientist in a lab coat (white male) that students/parents/teachers see. I think its important for kids to see that there should be different types of science careers they can pursue. I think that math gets a bad reputation (from the parents): Parent, "I can't help my child learn math because I'm bad at it" Students hear "I can't" and "bad at it" and kids are negatively encouraged not to pursue math. **MIS-ENG MIS-GEK**
-Yes there are common misperceptions. White male in a lab coat **MIS-CAR MIS-ENG**
-I think it's more the observations that I make. Boys are geared more towards engineering. Engineering sounds and seems to be more masculine. My daughters could become engineers but people think that it takes a lot of strength but there's a lot of brain power involved as well. **MIS-ENG MIS**
-One is the female thing. Students are surprised that women are able to do hands-on design. My colleagues not so much. We've been doing engineering for 4 years now. So we've gotten use to trying new things. **MIS-ENG**
-Not so much my colleagues. When we start, the kids usually have no idea what engineering is. They have a sense that it's designing cars and buildings, but they don't understand how it relates to general science. Stereo-types: they think it's all males. **MIS-CAR MIS-ENG**
-Not now. I'm in a different district. In Worcester, I saw some girls that were intimidated. "Engineering is for the smart people, not me." It's almost cool to be math literate. I don't find that to be true as much now in the school I'm in. It is more prevalent in Worcester due to economic reasons. Where I teach now, people are more educated. There was a gap between math and science, very little overlap. I still think that there's something happening in HS where girls veer away from engineering. The social environment plays a big role in misperceptions about engineering but I can't say that that's the only thing. **MIS-CAR MIS-ENG**
-Male oriented career **MIS-ENG**
-There is definitely still the image that there are males, and that they're nerds. **MIS-ENG MIS-GEK**
-Males, designs cars and buildings **MIS-ENG MIS-CAR**

(CAR) Engineering as a career

-I had limited knowledge. When I was in high school, a lot of students wanted to pursue a career in engineering because their parents were engineers. My parents weren't so I didn't know about

engineering. If you build something then you're an engineer. You can get a great job and pays a lot of money. It's about problem solving. And later I learned why students want to be an engineer. CR let me learn that there's more. In regards to problem solving, I liked going Bose factory. We want to make something that can see inside of patients. Talked to the engineers and helped me understand engineering more. Helping people live better lives. **MIS-CAR IK-CAR**
-Before CR I had a very vague notion of engineering (narrow notion). After CR I realized that this was something that I would've really liked to go into as a student. I thought that it was for very smart people and just for boys when I was in high school. **MIS-CAR MIS-ENG**
-Sure. There are the "geek" stereotypes. Also, people don't realize that there's a lot of interaction with people – that problems are solved alone. We have to solve problems in teams. You have to be creative. **MIS-GEK MIS-CAR**
-Yes. Some of the stereo types out there is that engineering is not really for creative people, that its more for science and math oriented people. It's a "nerd" profession. I do encourage kids to explore that profession. **MIS-CAR MIS-GEK**
-I see that the kids view STEM as nerdy. But some kids don't care and do "nerdy things" like robotics competitions. People perceive engineering as being extremely difficult. Society takes things that are more doable for them and see engineering and sciences as difficult and stress causing, even when ppl come home. **MIS-GEK MIS-CAR**
-Yes there are common misperceptions. White male in a lab coat **MIS-CAR MIS-ENG**
-I haven't had any conversation with my colleagues. But in science, generally students have misconceptions: white suit w a pocket protector. I took my students to Alden labs, where we did lab tests with water. They were surprised the professor didn't look a scientist. He was normal! I think that most people don't think of engineers see engineers as they are. They seem to think "pipes and hardhats" when it comes to engineers. However there are a few TV shows that help them (Design Squad). Perceptions are changing a bit. **MIS-CAR MIS-GEK**
-I've heard my colleagues say things like engineers are more detailed oriented, but they don't see the big picture. I've also hear people say that engineers are more introverted. I've never heard parents or students say anything about engineers though (they don't link engineering with me because of my subject). **MIS-CAR**
-Not so much my colleagues. When we start, the kids usually have no idea what engineering is. They have a sense that it's designing cars and buildings, but they don't understand how it relates to general science. Stereo-types: they think it's all males. **MIS-CAR MIS-ENG**
-Not now. I'm in a different district. In Worcester, I saw some girls that were intimidated. "Engineering is for the smart people, not me." It's almost cool to be math literate. I don't find that to be true as much now in the school I'm in. It is more prevalent in Worcester due to economic reasons. Where I teach now, people are more educated. There was a gap between math and science, very little overlap. I still think that there's something happening in HS where girls veer away from engineering. The social environment plays a big role in misperceptions about engineering but I can't say that that's the only thing. **MIS-CAR MIS-ENG**
-Huge misconceptions not only about engineering, but on the term STEM. People think that it must mean you pursue a career in science (scientist, engineer, etc.). STEM is the way you think about these 4 subjects among faculty, students and parents. Also, using related skills to create solutions. **MIS-CAR**
-My colleagues seem very knowledge about engineering; the tech program at the school probably helps with that. A lot of the tech/science teachers have daughters/sons that are engineers. We have a tech program that kids can be involved in if they chose to when they get to HS. The exposure to the tech program in middle school, some of our students are better informed about engineering. However there are still misconceptions about engineering. For example, the wide range of engineering that is available. I use examples of my daughter or husband. I feel like showing them real suggestions make things more realistic for them. **MIS-CAR**
-Nerd, lab coat **MIS-GEK MIS-CAR**
-They think it's not stable. I don't think kids have enough opportunities in my town. They don't understand what the career could be like. **MIS-CAR**
-Males, designs cars and buildings **MIS-ENG MIS-CAR**

(GEK) There is a "Geek" factor

-Absolutely. I think there is the traditional scientist in a lab coat (white male) that students/parents/teachers see. I think it's important for kids to see that there should be different types of science careers they can pursue. I think that math gets a bad reputation (from the parents): Parent, "I can't help my child learn math because I'm bad at it" Students hear "I can't" and "bad at it" and kids are negatively encouraged not to pursue math. **MIS-ENG MIS-GEK**

-Sure. There are the "geek" stereotypes. Also, people don't realize that there's a lot of interaction with people – that problems are solved alone. We have to solve problems in teams. You have to be creative. **MIS-GEK MIS-CAR**

-Yes. Some of the stereo types out there is that engineering is not really for creative people, that its more for science and math oriented people. It's a "nerd" profession. I do encourage kids to explore that profession. **MIS-CAR MIS-GEK**

-I see that the kids view STEM as nerdy. But some kids don't care and do "nerdy things" like robotics competitions. People perceive engineering as being extremely difficult. Society takes things that are more doable for them and see engineering and sciences as difficult and stress causing, even when ppl come home. **MIS-GEK MIS-CAR**

-I haven't had any conversation with my colleagues. But in science, generally students have misconceptions: white suit w a pocket protector. I took my students to Alden labs, where we did lab tests with water. They were surprised the professor didn't look a scientist. He was normal! I think that most people don't think of engineers see engineers as they are. They seem to think "pipes and hardhats" when it comes to engineers. However there are a few TV shows that help them (Design Squad). Perceptions are changing a bit. **MIS-CAR MIS-GEK**

-Nerdy, difficult, stressful **MIS-GEK**

-There is definitely still the image that there are males, and that they're nerds. **MIS-ENG MIS-GEK**

-Nerd, lab coat **MIS-GEK MIS-CAR**

(PPDP) Post- Camp Reach-Professional Development Programs attended

(STEM) Focus on STEM subjects

-Before CR I didn't do any other PDPs. After that I did a year with an MLC (math learning center) where you work with other math teachers to see what you can do with student work. ASSESsments at WPI **PPDP-STEM**

-I did no PDPs prior to CR. After CR there were two different summers where I was invited back to WPI helped with some research that developed science/engineering activities for HS/MS students. During the research we did a couple of experiments and played with toys. Teachers with Engineering (WPI: 4 summers ago), Worked in a Lab, imaging anthrax, Finished my second MS in geo-sciences **PPDP-STEM**

-Before CR, nothing. There wasn't much available. Since CR, NST there was a conference that took place and almost all classes were STEM classes. It's becoming more prevalent that STEM is working its way in. Life science: STEM is minimal. I'm trying to satisfy what MA wants and little of what I want. It's a big time commitment and to get training. And if state doesn't require it then it's hard to incorporate due to the current states curriculum demands. **PPDP-STEM CR**

-There are a lot of tech programs now. I have learned a lot about GoogleDocs and sharing sites. In my PDPs offered by the school I need to choose an interest group and I have been choosing technology ones. **PPDP-STEM**

-I had a Masters in teaching math and science at Tufts. I worked at a Jason camp before Camp Reach. After: Project at UMass Lowell – Northeast Pipeline STEM project. 2 year project study with the school. Looked at a program that 5th and 6th graders have on MCAST scores **PPDP-STEM**

-Before CR I was one of the trainers for PALS where it connect math and science. I was always constantly in training – whether it was helping or participating. After CR one of the things I did was that I had a fellowship in research in UMass Amherst. I've done robotics training since then. I've also had my kids make some wind turbines where they have to design the blades. There are more, but I can't remember. **PPDP-STEM**

-Inquiry of Science Classrooms: built as a STEM workshop. Did no challenges, more inquiry based. Did nothing specifically engineering. NSCA: felt like they had done it already. Using a TV show that was related to structure of the 1 hr workshop **PPDP-STEM**

-I've done a NASA summer camp two years ago. We spent three weeks designing the camp, and it ended up being one week of activities for the kids. We did activities with gyroscopes, wings, wind machine, and an airplane computer program. **PPDP-STEM**
-I went to WPI for Teach Engineering. Teachers had to develop online lesson plans. It was an online resource for teachers. **PPDP-STEM**
-Engineering workshops by WPI (museum of science). They were Engineering Saturdays . Another one by MOS, used a camera and using engineering design process. This experiment was used in CR. After been continual professional development for biology. Specifically related to STEM, there are Science fair and TSIP (thinking science inquiry process). **PPDP-STEM**
-The RAT program at NEU and a UMASS program. **PPDP-STEM**

(NO) None

-I've done more PDPs involving boarding schools, not so much in math/science. **PPDP-NO**
-My major was with structural technology. I haven't done anything else other than CR. **PPDP-NO**
-Nothing that was officially called a PDP. I have taken a few more courses to get my professional license, but I can't say anything that was specifically a STEM program. **PPDP-NO**
-Nothing besides CR **PPDP-NO**
-Nothing besides CR **PPDP-NO**
-I've done a lot of professional development programs but not about STEM. I've done stuff about curriculum. I have 3 kids now so I don't have much time. Before, the professional development program was about math curriculum and how to apply it into our classrooms. I did this while getting my masters at WPI and they overlapped a lot. **PPDP-NO**

(PDP) Desired Professional Development Program Attributes

(ILP) Implement Lesson Plans

-Commitment from the administrators, information/activities that you can use in the classroom, time that you can use in the classroom creatively…time is so valuable that it's hard to do this. **PDP-EP PDP-ILP PDP-TIM**
-Experienced presenters. I want to go to PD programs with teachers who have experience and know teaching methods. I don't go to a lot, it's all about time. Don't get much time to go to workshops and many are during school year. MA wants teachers to get lots of experience but we have to manage with school. I get to go to 2 a year if I'm lucky.- - At one of the programs we met at the end of each school day, so we incorporate certain things into the next day. (By talking with the other teachers we gained ideas of different approaches/activities we could use in our classes. By meeting at the end of the day we could plan our activities for the next day and incorporate some of the ideas that we had learned. This way we didn't forget all the useful ideas/things we had heard about) It is difficult to take PD programs during the school year. **PDP-EP PDP-TIM PDP-TS PDP-ILP**
-Anything you can apply immediately. This means giving teachers a chance to do this while it is fresh in their mind. **PDP-ILP**
-Making sure that the program helps teachers understand how teachers can apply these things to their classroom. For example a study or lesson plan connected in the program. **PDP-ILP**
-I'm not incorporating anything from CR into my classroom. For PD I have attended a full day conference in RI where I looked for specific take aways from the program that I can definitely incorporate into our program. We want things that we don't need to alter a lot to use in our classroom. I guess a strong one is opening our minds and giving teachers more creative ways to look at and approach things. **PDP-ILP PDP-EP**
-Overall the strong ones are the ones that aren't dumbed down for people that don't know science or math. I think PDPs need to be more clear about what teachers they should attract to these programs. I'm not an English major. Have something intellectually challenging! Also, it's great when I can bring back activities from the camp. **PDP-EP PDP-TOT PDP-ILP**
-You had a whole lesson plan by a few years into the program. Teachers were like the students. We had to put together vehicles and identify possible problems that the students may run into as they were going through the lessons. **PDP-ILP PDP-EP**
-It needs to be interactive. A person presenting cannot talk to only me the whole time. I need to be able to do what their saying. Not necessarily hands on, but interactive. There needs to be an end

product. There needs to be a clear outcome so I can use in classroom (lesson plan, lab). **PDP-EP PDP-ILP**

(TOT) Types of Teachers

-As a math teacher, when you take a PDP you hear "this works great in a BLANK classroom" but they never have examples of how to incorporate things into a MATH classroom. They have more specific things for science, technology, history, etc. But nothing is really detailed specifically for math. It would be great to have an example that math teachers can have. **PDP-TOT**

-Overall the strong ones are the ones that aren't dumbed down for people that don't know science or math. I think PDPs need to be more clear about what teachers they should attract to these programs. I'm not an English major. Have something intellectually challenging! Also, it's great when I can bring back activities from the camp. **PDP-EP PDP-TOT PDP-ILP**

(EP) Engaging Program

-Commitment from the administrators, information/activities that you can use in the classroom, time that you can use in the classroom creatively…time is so valuable that it's hard to do this. **PDP-EP PDP-ILP PDP-TIM**

-Any experience that makes you think is effective. Like making me think of my own style of teaching, or how I handle children. It pushes me to think how I teach and get my points across. Learning different styles of teaching is also effective. **PDP-EP PDP-TS**

-Experienced presenters. I want to go to PD programs with teachers who have experience and know teaching methods. I don't go to a lot, it's all about time. Don't get much time to go to workshops and many are during school year. MA wants teachers to get lots of experience but we have to manage with school. I get to go to 2 a year if I'm lucky – At one of the programs we met at the end of each school day, so we incorporate certain things into the next day. (By talking with the other teachers we gained ideas of different approaches/activities we could use in our classes. By meeting at the end of the day we could plan our activities for the next day and incorporate some of the ideas that we had learned. This way we didn't forget all the useful ideas/things we had heard about) It is difficult to take PD programs during the school year. **PDP-EP PDP-TIM PDP-TS PDP-ILP**

-The presence of people really knowing their fields. All the training they give will not matter if the teachers aren't skilled at planning or timing in their curriculum. **PDP-EP**

-I'm not incorporating anything from CR into my classroom. For PD I have attended a full day conference in RI where I looked for specific take aways from the program that I can definitely incorporate into our program. We want things that we don't need to alter a lot to use in our classroom. I guess a strong one is opening our minds and giving teachers more creative ways to look at and approach things. **PDP-ILP PDP-EP**

-One thing that many of my colleagues feel and I feel that PDPs that are more hands on with a product are much more effective than lectures. **PDP-EP**

-Overall the strong ones are the ones that aren't dumbed down for people that don't know science or math. I think PDPs need to be more clear about what teachers they should attract to these programs. I'm not an English major. Have something intellectually challenging! Also, it's great when I can bring back activities from the camp. **PDP-EP PDP-TOT PDP-ILP**

-You had a whole lesson plan by a few years into the program. Teachers were like the students. We had to put together vehicles and identify possible problems that the students may run into as they were going through the lessons. **PDP-ILP PDP-EP**

-It needs to be interactive. A person presenting cannot talk to only me the whole time. I need to be able to do what their saying. Not necessarily hands on, but interactive. There needs to be an end product. There needs to be a clear outcome so I can use in classroom (lesson plan, lab). **PDP-EP PDP-ILP**

(TS) Teach new Teaching Styles

-Any experience that makes you think is effective. Like making me think of my own style of teaching, or how I handle children. It pushes me to think how I teach and get my points across. Learning different styles of teaching is also effective. **PDP-EP PDP-TS**

-The strongest ones allow me to learn new skills and techniques that I can bring back to myv students. (Even if I have to change the skills/activities a little to fit my classroom). I like to be a

model to my students: show them that learning is a lifetime endeavor and that they will always be learning. **PDP-TS**

-Experienced presenters. I want to go to PD programs with teachers who have experience and know teaching methods. I don't go to a lot, it's all about time. Don't get much time to go to workshops and many are during school year. MA wants teachers to get lots of experience but we have to manage with school. I get to go to 2 a year if I'm lucky.- - At one of the programs we met at the end of each school day, so we incorporate certain things into the next day. (By talking with the other teachers we gained ideas of different approaches/activities we could use in our classes. By meeting at the end of the day we could plan our activities for the next day and incorporate some of the ideas that we had learned. This way we didn't forget all the useful ideas/things we had heard about) It is difficult to take PD programs during the school year. **PDP-EP PDP-TIM PDP-TS PDP-ILP**

(TIM) Time

-Commitment from the administrators, information/activities that you can use in the classroom, time that you can use in the classroom creatively…time is so valuable that it's hard to do this. **PDP-EP PDP-ILP PDP-TIM**

-Experienced presenters. I want to go to PD programs with teachers who have experience and know teaching methods. I don't go to a lot, it's all about time. Don't get much time to go to workshops and many are during school year. MA wants teachers to get lots of experience but we have to manage with school. I get to go to 2 a year if I'm lucky.- - At one of the programs we met at the end of each school day, so we incorporate certain things into the next day. (By talking with the other teachers we gained ideas of different approaches/activities we could use in our classes. By meeting at the end of the day we could plan our activities for the next day and incorporate some of the ideas that we had learned. This way we didnt forget all the useful ideas/things we had heard about) It is difficult to take PD programs during the school year. **PDP-EP PDP-TIM PDP-TS PDP-ILP**

(SUG) Suggestions for Improvement as a PDP

(ILP) Implementable Lesson Plans

-At the end of the program, if they could break down the camp for the teachers: what can the teachers do in a day/lesson that the teachers to incorporate engineering. This would make it more feasible for the teachers to do this in their classrooms. **SUG-ILP**

-If it's going to be used as a Professional Development Program then teachers might want to be teachers who teachers are teaching engineering, math and life science. Doesn't have to be but as a PDP for STEM subjects then it may be more helpful to teaching who actually teach it and can incorporate it would benefit from it. The concepts are a little difficult. But when Kids see the actual model and can see how the concepts apply. The activities aren't ones that teachers would implement in school. I have 18 life science frameworks and 20 core curricula that I have to abide by. Would be fun to take a day to build but there's not much time. **SUG-OTH SUG-TOT SUG-ILP CR**

-As I was doing the program I wasn't thinking that it was a PDP. I didn't see it bettering me, but I was more of a facilitator for the girls. I was there to help the camp. I found CR very valuable and fun, but I didn't see it as a PDP. Maybe more training about the engineering aspects to connecting it with we can get out of CR. More training with a tutorial format so that they can help the girls but also have the knowledge that they apply to their classes afterwards. **SUG-ILP**

(TOT) Types of Teachers

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-Our tech-eng teachers can incorporate the things CR teaches into their program. Maybe CR should hire more tech-eng teachers instead of math/science teachers. Make time during the day for the MST to sit and get to know the TAs so they can work as a time. There were some disagreements between the TAs and the MSTs. (Need to facilitate the TAs better). **SUG-TOT CW-SUG**

-I can't think of any specifically. CR wasn't intended to be a "math" program. There are math and science teachers that tend to be the main contributors to the CR program. If there were more take-aways that math/science MSTs can use. **SUG-TOT**

(OUT) Outreach

-I would like to see them PR more. I hadn't heard about it until John told me. Maybe representatives coming to the schools and talking to the teachers of students about CR would help promote the camp more. Or perhaps sending a kit to schools where the teachers can have a hands on program that CR does….a preview of what CR is. **SUG-OUT**

-CR does a nice job with the teachers like providing opportunities for social networking. Maybe a web based application where teachers can post things that they took from CR into their classrooms. Gives other teachers the opportunity to see what other MA teachers do (because they use all the same standards). **SUG-OUT**

-I really "lived" CR (they can't get rid of me). CR should do a follow up with the teachers. I've made use of the professors at CR b/c they've made themselves available to me. I've had the professors in my classrooms, helping me in my classes, and giving me advice. WPI has been a wonderful resource for me. I don't know if other teachers do this. I was in the training for the summer every year between the time Denise died. One year they had me speak to the parents. It's been very good for me to keep in contact. It's very hard for teachers to pick things up from other teachers because they don't know how to do this type of work – they don't know how to collaborate like they should. **SUG-OUT**

-They only had female teachers when I was there. Try to get the word out more. Maybe offer it for credit. I did try to get teachers involved in it and they didn't show interest really. Maybe teachers who are just breaking into education, while veteran teachers like their time off. Offer professional development points or some kind of credit so teachers are required to take it. Possibly be brought on site to science or math departments. **SUG-OUT SUG-OTH**

-I always wanted to come back. I always read about their competing program. There wasn't a shortage of girls in program. There's a problem about whether the girls become engineers. Best part was going to Bose. That was the amazing part. A lady there was the first engineer at Bose. That floored me because I didn't expect women to be women would've been around before that. It's important that there are efforts to involve girls. CR can reach out to more schools. Multiple teachers can work together on the projects in the district. **SUG-OTH SW SUG-OUT**

(OTH) Other

-Don't limit it to 6th or 7th grade girls. Or maybe have another program for 8th grade girls. The number of girls was a hard dynamic, but it was great to have that many girls. I don't know what there is to have a specific change. Better promotion: Get representative from WPI to the schools. Calling on the former MSTs to have them talk to the other schools. Teachers would like to talk to other MSTs that have been through the program. **CW-SUG SUG-OTH**

-I think it's a really good opportunity for the MSTs that are involved. I'm not sure if a lot of the regulations have changed, but I think that they should allow people to come back for additional years; it would've been nice to return back after the fact. **SUG-OTH**

-If it's going to be used as a Professional Development Program then teachers might want to be teachers who teachers are teaching engineering, math and life science. Doesn't have to be but as a PDP for STEM subjects then it may be more helpful to teaching who actually teach it and can incorporate it would benefit from it. The concepts are a little difficult. But when Kids see the actual model and can see how the concepts apply. The activities aren't ones that teachers would implement in school. I have 18 life science frameworks and 20 core curricula that I have to abide by. Would be fun to take a day to build but there's not much time. **SUG-OTH SUG-TEA SUG-PDP-LES CR**

-What CR does is fabulous. I think the biggest problem in general (for any program) is finding authentic programs for the girls to work on. There wasn't a huge emphasis on the PDP part in the orientation. But the end product was what was going on with the girls. The way the professors deliver the content so that there is a consistent way for the teachers to see how they can implement. For example: making it specific what the end project presentation should cover. That way the teachers can see what they could expect with the project if they did. There should be a break for the TAs…but I don't see how that can happen. The girls weren't keeping a notebook. It was great because the whole thing was very relaxed and the girls excelled without a grade. **CW-SUG SUG-OTH**

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-It's hard to say because it was so long ago. I didn't see it as a professional development program. I saw it as an opportunity to work with different students in a different setting. A suggestion is the ability to volunteer. Teachers come in and help out during activities and doing them along with the girls. **SUG-OTH**

-I always wanted to come back. I always read about their competing program. There wasn't a shortage of girls in program. There's a problem about whether the girls become engineers. Best part was going to Bose. That was the amazing part. A lady there was the first engineer at Bose. That floored me because I didn't expect women to be women would've been around before that. It's important that there are efforts to involve girls. CR can reach out to more schools. Multiple teachers can work together on the projects in the district. **SUG-OTH SW SUG-OUT**

(NS) No Constructive/Useful Suggestions/Comments

-Not for technology. I used technology every day. I WAS THE FIRST TEACHER IN OUR DISTRICT TO USE EMAIL. Used instruction cps. I was the first to incorporate cps in district. Technology is not hindered in our curriculum. But, so little engineering is applied to what I do. **NS**

-I went to WPI, and my neighbor works at WPI. CR sends flyers to the school, but I considered it when a friend suggested it. Chrys was interested why I was interested in teaching girls b/c I'm a male. We got past that quickly though. Since the campers are ascending 7th graders, there is a definite different dynamic as a male teacher to the female students. **NS**

-I had applied 3 years before attending. A friend worked there and he told me about CR. He mentioned that I might want to work there or enroll my daughter. Interviewed with Chrys and chose somebody else. Later, Tracy Lavengood came to me and said that they were trying to get people from Mount Hope. I interviewed with Sue Sontegrath and Audra and got the job. I work in the summer and was trying to do something new. I usually do summer school with special needs. Middle school kids are the age group that I usually work with. **NS**

-I had received information about the program and passed it along to my students. I knew that they had enjoyed it. I knew that the girls had learned a lot that helped them with their 7th and 8th grade classes, so I thought I could learn a little about things that could help my 6th grade students. **NS**

-John was approached to return and they were looking to have all three teachers from our school to participate in the camp. He approached me so I applied to CR. **NS**

-I heard about it through a friend of mine, who went to CR. She had great things to say about it and had a wonderful time. She's a math teacher, so I was concerned that I wouldn't fit in as a science teacher. But I really made a connection with the program once I got there. Everyone has something to offer CR when they attend. **NS**

-It was the summer of 2003. I had just become a certified and it sounded like a very interesting program that would bring my two careers together and it did do that. **NS**

-An email or letter. I love working with kids. I thought it would be a different way to be able to work with kids who are truly interested in science . I love science and teaching it so it was good fit. **NS**

-Everything (she attended last year) **NS**

-I remember wishing that I knew about engineering because I would've loved to be one. I also remember the effect that CR had on the kids – they loved it! **NS**

-I think about it a lot so it had some effect. I worked with some HS girls and they were so caught up with cell phones. The rules were that no cell phones allowed around the girls (campers). Cell phones will take over your life. Nice to make some connections with sue and audra. Also, it was nice to see what WPI has to offer. Short term effect: I met my future students and nice to have that connection with kids. **NS**

-Not that I can think of. **NS**

-I think so. I've think I've learned how to give kids an opportunity to come up with - Financially (haha). I also really enjoyed meeting Sue. Camp Reach/Sue keeps in touch. And CR is a good networking experience. I know that if I needed something Sue could help me. **NS**

-It allowed me to build relationships. For example, Martha Cyr. Also, having resources available for me and my students. **NS**
-It was nice to see the other engineer careers. (Definite prior knowledge) **NS**
-No prior knowledge **NS**
-I had no prior knowledge to engineering as a career before. I knew about engineering and that it helps develop our world, but that's really it. I feel like I don't apply a lot of what I learned now. **NS**
-I don't remember it changing. One session about robotics that was eye opening. When I was in school it was an early development of the robot. It was nice to see girls competing with their own robots. I saw a development in the robotics field. Mechanical stuff kind of stayed the same. **NS**
-I don't think so. **NS**
-Because I was teaching biology, no. WPI helps with engineering thought processes and getting technical skills. **NS**
-It's hard to remember all the workshops. However, I remember wanting to learn more about the software that the kids used where they were trying to build things to help handicapped people. I didn't have enough experience with the software to help the kids. **NS**
-I can't remember. The girls were building something. **NS**
-I don't remember **NS**
-None of the workshops. I have done robotics, but that wasn't initially part of CR. **NS**
-I haven't had a specific confirmation about that. When I advertise for another camp at WPI they seemed like they didn't want to do an engineering activity because it doesn't seem like "it was for them." **NS**
-I think that everybody is more educated about it. You see it, you hear about it, versus when I was growing up. It's headed in the right direction. Everybody has more of an awareness, that gender doesn't matter and its based on your strengths. **NS**
-Not from colleagues or parents. I think kids don't have enough options about engineering. **NS**
-MLC work with other teachers to see what you can do with student work **NS**
-WPI research - developed science/engineering activities for HS/MS students **NS**
-Research **NS**
-Activities connecting math and science, robotics activities, wind turbine designs **NS**
-Activities with gyroscopes, wings, wind machines, and an airplane program **NS**
-More of a mindset. One … class at UMASS. We transferred gelatin…. It's the way you manage the whole experience. We always worked as a group. It's about making it a learning experience. **NS**
-I really don't. I thought it was a great camp! **NS**
-They were more science based and I've been a math teacher. For the most part, no. Those lessons would take a week or two to incorporate, which I didn't have. **NS**
-It never seemed to hinder the ability. But the tasks related to engineering didn't seem completely accurate to what engineering is. Kids are tested early (5th grade) for the MA standards (some of the standards questions are on engineering). **N**